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DECEMBER · 35c *Monthly*

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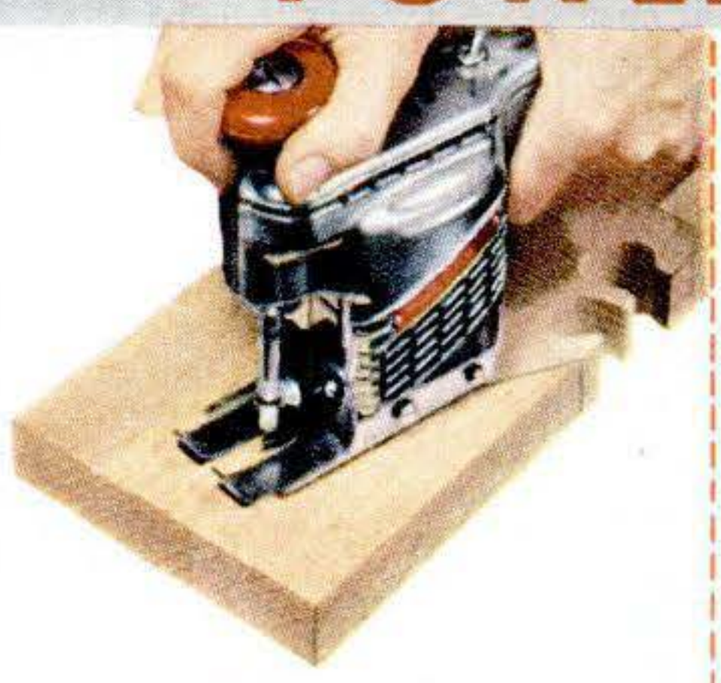

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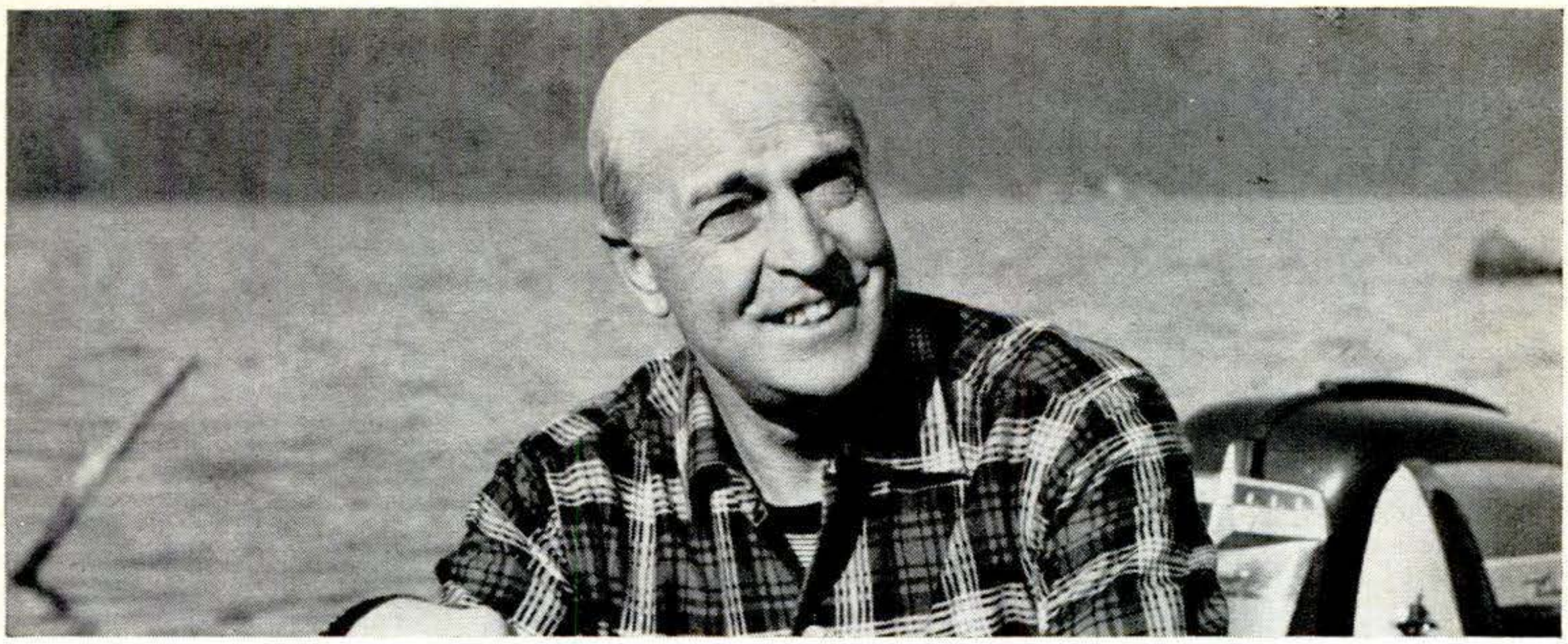

How I retired in 15 years with $300 a month

"Here's one Yankee who's fallen in love with the South! When I retired, I moved to the Florida West Coast. I go fishing in the inlets. It's a tropical paradise, yet it's near enough to drive into Tampa often. I'm beginning a new life —all because of the check for $300 I get each month.

"My retiring came out of a business trip to Tampa in 1942. I was dining at a restaurant and happened to notice Don Nelson, a friend of mine from New York. I went over to wish him a wonderful vacation.

"'Vacation? Why, didn't you know we moved down here when I retired?'

"I was amazed. 'But you're too young to be retired!'

"'Nonsense!' he smiled. 'It's what I'd been planning for fifteen years.'

"Don invited me out to his home the next day. 'I sure envy you, I said. 'I know I never could save enough money.' Then Don explained that he never could have retired on what investments or savings he had. But he had a good salary and he had found a way to make part of his salary buy a retirement income. It was called the Phoenix Mutual Retirement Income Plan.

"Flying home, I noticed a Phoenix Mutual ad in a magazine. Sure enough, I could get a retirement income guaranteed for life if I started young enough. When I got home, I cut out the coupon and sent for the booklet telling all about Phoenix Mutual Plans. In a few days it came by mail. And there was exactly the plan for me. If I started right then—at 40—I'd be able to retire in only fifteen years with $300 a month.

"I felt more and more pleased and secure as those fifteen years went by. I decided on the West Coast of Florida because I had old friends in that area. And as soon as my first check for $300 arrived, I was off. Now that I'm settled, the real fun's just beginning."

Send for Free Booklet

This story is typical. Assuming you start at a young enough age, you can plan to have an income of $20 a month to $3,600 a year or more—beginning at age 55, 60, 65 or older. Send the coupon and receive, by mail and without charge, a booklet which tells about the Phoenix Mutual Plans. Similar plans are available for women. Don't delay. Send for your copy now.

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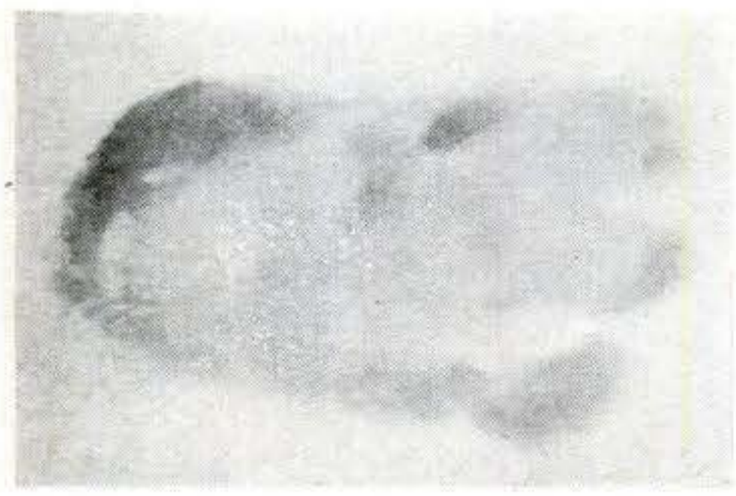
Founded in 1872 Vol. 171: No. 6 *Mechanics and Handicraft* REG. U. S. PAT. OFF.

Popular Science Monthly

December, 1957

Formula: drape three two-barrel pots over the biggest engine in the business. Stir in a hot cam. Result: whoosh!



Made by man or beast? Scientists search high in the Himalayas for the Abominable Snowman

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Circulation Director
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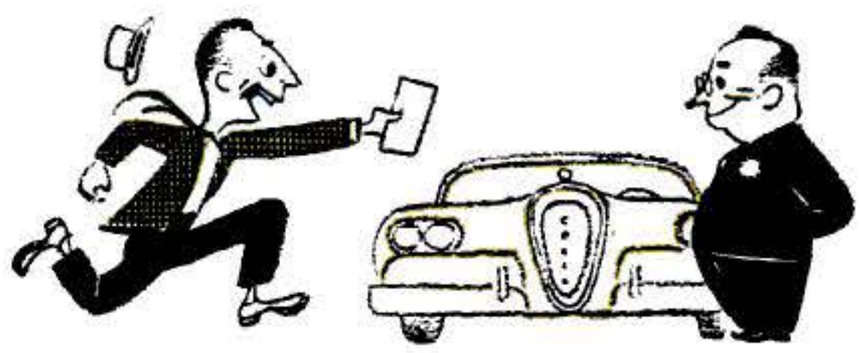
PS Readers

TALK BACK

Expectant Owner Is Ready

WHEN it comes to "being prepared" the editors of POPULAR SCIENCE could give lessons to the Boy Scouts. I got a kick out of reading your article "How to Take Care of an Edsel" [Sept.]—before the car had even been unveiled to the public. Reminded me of those classes they have for expectant fathers on how to feed and diaper baby.

Is there an Edsel in my future? With that grille and finless rear, here's one car



—thank heavens!—that looks a little different from the rest. I'm going to save that data on how to adjust the idle mixture and the accelerator pump—just in case my sweepstakes ticket pays off.

G. K. WORTH, Freeport, N.Y.

Warning on Meter Cabinets

YOUR article on living in a basement [Sept.] shows a gas meter enclosed in knotty pine. Many utility companies discourage enclosures for these reasons:

1. Inaccessibility: Meters are tested for accuracy and safety about twice yearly; replaced about every fifth year.

2. Safety hazard: Any leak could cause gas to build up in the small enclosure. Chances are a homeowner wouldn't detect it until seepage from the cabinet was sufficient to cause an explosion.

I suggest that your readers consult their utility company before building an enclosure.

A. R. MASSENA, Inspector,
Northern Indiana Public
Service Co., Gary, Ind.

Truck Wheels into Wrong Town

EVEN here on Thule Air Base, Greenland, I can spot a minor error in a caption in your article, "Your New Car's First Trip," September. The city you call Syracuse on page 133 is none other than my old home town—Rochester, N.Y. The street is Monroe Avenue, looking west, to be exact.

A/2C G. W. WALL, APO, NY

. . . In your story about the driver of a car "haulaway," a caption under a picture says delivery is being made in Syracuse. If this is the case, how come I got my Archer Ford in Rochester? Was this just a misprint or does the driver need to read his routing sheet more closely?

ALAN LIPIDES, Rochester, N.Y.

That skid mark on the geography book was made by a red-faced PS editor.

Straight Talks Praised

I AM writing to tell you that I can not remember ever reading a series of articles anywhere, in any magazine, that gave me more pleasure and food for thought than your series "Straight Talk to Parents."

DR. COEN OOSTHUYSEN
Vereeniging, Transvaal

. . . The August Straight Talk to Parents article ("You *Can* Afford to Send Your Child to College") was highly informative, but hardly does justice to the small liberal-arts colleges. These number about 750 out of the nearly 1,900 colleges and universities in America.

Parents scared away by expenses at the large universities you list might pick up

courage if they were aware that for half the cost they could send their children to thoroughly reputable institutions like Allegheny, Dickinson, Davidson, Southwestern-at-Memphis, Augustana of Illi-

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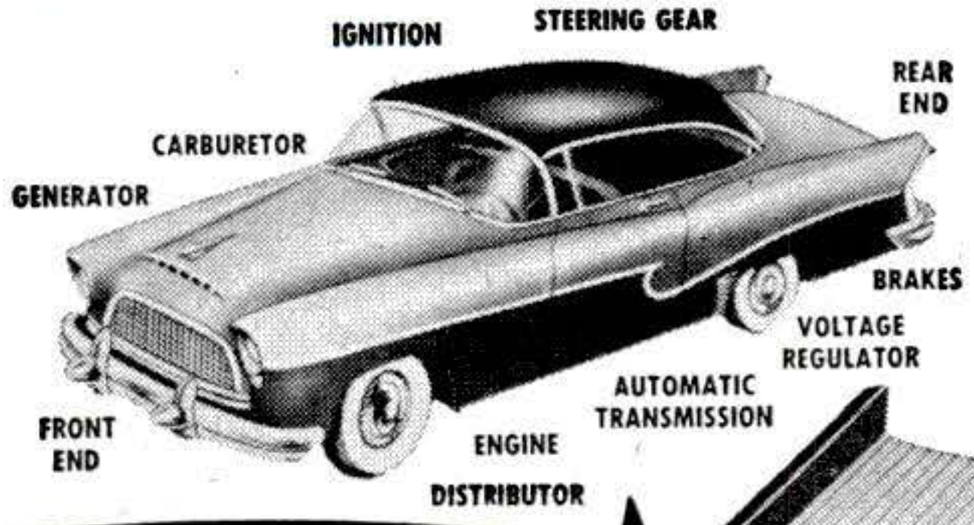

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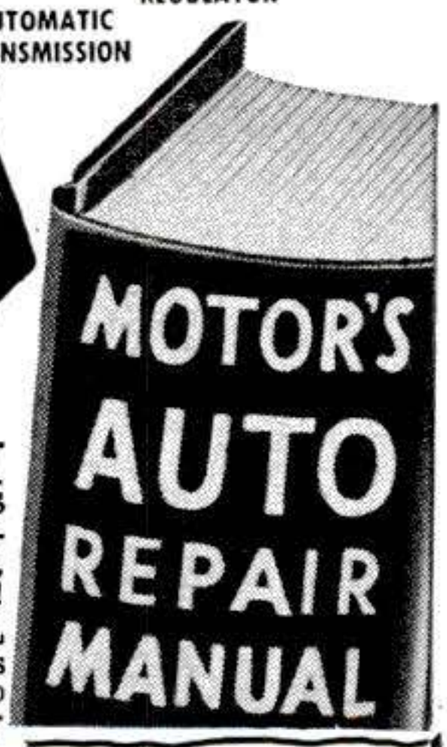

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JAMES W. HAMPTON, Editor
The Small College Annual
Maryville, Tenn.

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PS Radio Is Family Favorite

"TOMORROW'S All-Purpose Radio" [July] so intrigued me that I built it. Volume, tone and selectivity are so good

that it is the favorite set in our house. It even plays in the car. And it is a first-rate phono amplifier. Two questions:

1. Is the battery passing any current when it is turned on but the condenser is between stations? The speaker is silent and no filaments are heating.

2. Can I get parts and circuits for a transistor FM radio? The antenna requirement might keep it from being portable, but portability is only one of the good things about the "radio of tomorrow."

J. A. STAFFORD, Tucson

The current draw from the batteries when there is no signal present is 12 milliamperes; at maximum signal it may go as high as 110 milliamps . . . Transistors and circuit components for FM are quite expensive and not readily available.

Schoolboy Weapon Repairs Tires

MAYBE some of your readers remember using the old rubber-band shooter to repair solid bike tires. I have successfully used this schoolboy trick to plug nail punctures in my car's tubeless tires.

The shooter is just a piece of heavy-gauge wire, forked at one end and hooked at the other. When loaded with rubber bands, the wire is poked into the punc-

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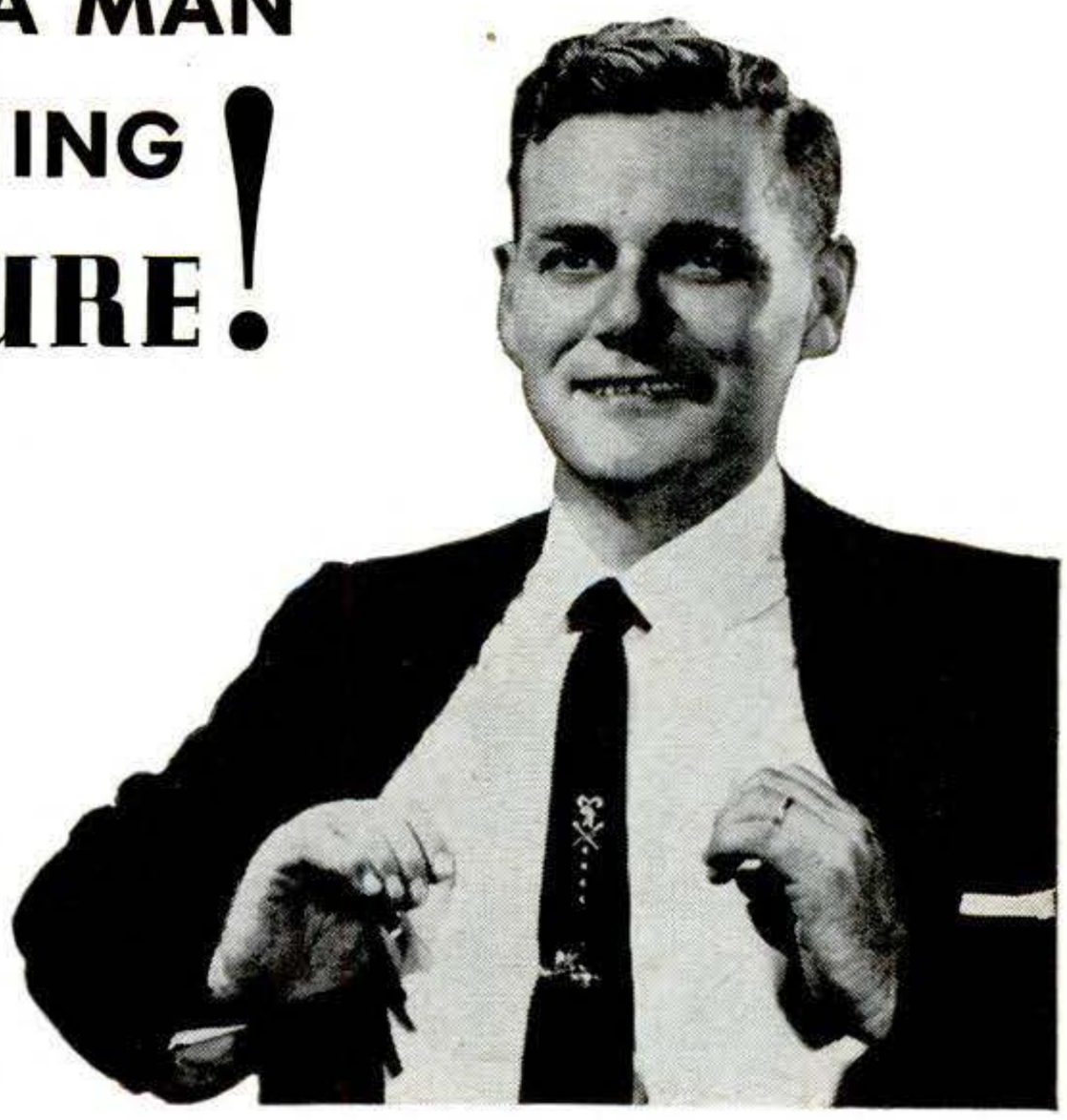
WHAT HAPPENS WHEN A MAN DECIDES TO DO SOMETHING ABOUT HIS FUTURE!



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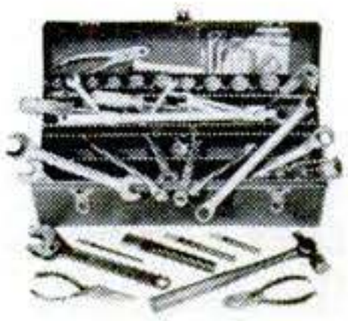

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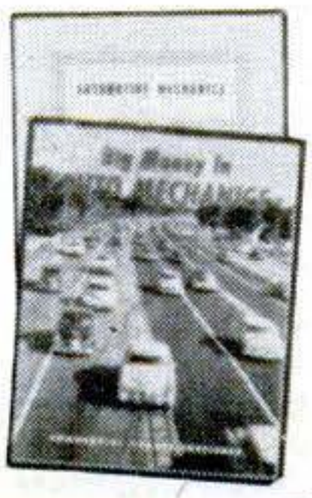


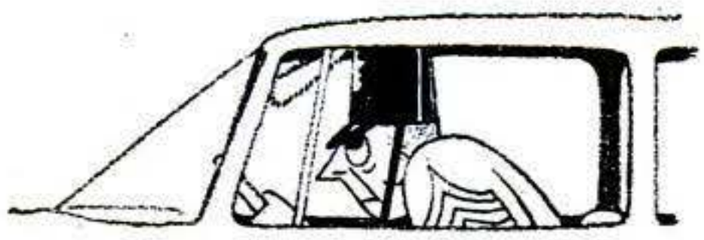
ture, the rubber bands are cut free at the top, and the wire is withdrawn.

I apply tube-patching cement generously to the hole before packing it with rubber bands. This not only lubricates the hole, but acts as a sealant.

J. J. BENEDICT, N. Evans, N.Y.

Cadets Get Ready to Roll

RECENTLY I read a pamphlet from the PS Reference Library entitled "How to Buy a New Car," and was impressed with the information in it. Each year at the Military Academy the graduating class



is confronted with the problem of buying cars. The automobile committee, after reading your booklet, is certain that it will greatly aid each graduating cadet when he purchases his car.

CADET JAMES H. JONES, USMA
West Point, N.Y.

He Wants Jumbo Treads

THE article "How to Buy Good Retreads" [Sept.] set me to thinking.

Why not double or triple the thickness of the tread? It would not only last longer, but blowouts would be fewer. With occasional inspection of the tread, you could extract nails before they penetrated the tube.

ANDREW VENA, Philadelphia

Heat is one factor that limits tread thickness. The heavier the tread, the more heat it builds up under flexing. Inflate hard enough to reduce flexing and the ride becomes hard. A thick tread would slowly change the wheel-to-road ratio, too. You'd be in "high gear" when the tire is new, come down as it wears.

A Safer Plug for TV Sets?

IN THE October "You Ought to Know" column, you suggest using a neon tester to make sure your TV set is plugged in safely. Since a hazard exists only when the plug of an AC-DC appliance is incorrectly inserted in a wall outlet, why don't set manufacturers put a simple built-in indicator on the line cord? Why not a neon tube in the plug itself, wired so that

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"Have my own Radio-TV shop. Average about $100 a week without advertising. NRI training my best investment."— LARRY P. MOTT, Miami, Fla.

"Am doing Radio and Television Servicing full time. Now have my own shop. I owe my success to N.R.I."—CURTIS STATH, Ft. Madison, Iowa.

"Am with WCOC. NRI course can't be beat. No trouble passing 1st class Radio-phone license exam."—JESSE W. PARKER, Meridian, Mississippi.

"By the time I graduated I had paid for my course, a car and testing equipment. Can service toughest jobs."—E. J. STREITENBERGER, New Boston, Ohio.

"Before finishing the NRI course I was employed as Studio Engineer at KMMJ. I am now announcing."—BILL DELZELL, Grand Island, Nebraska.

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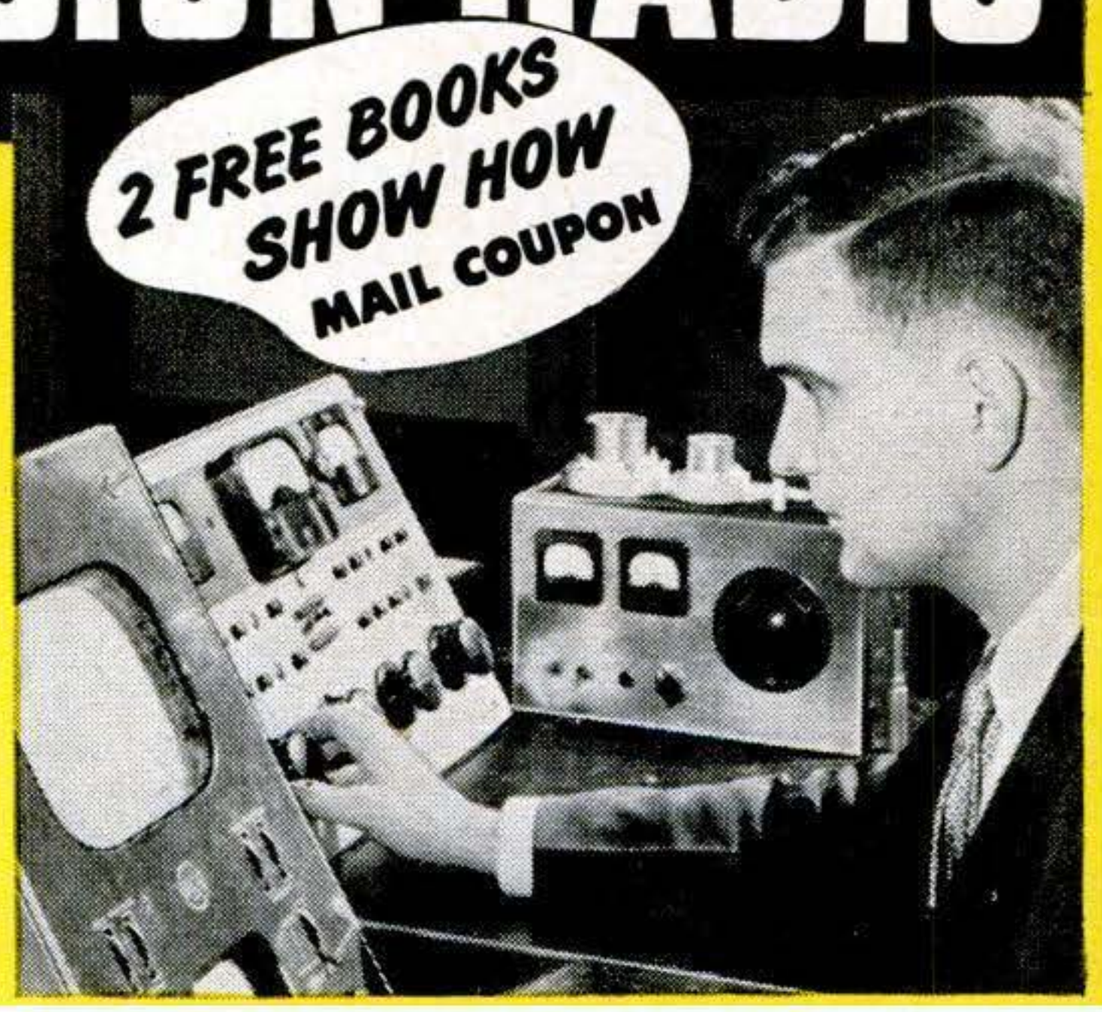
Start Soon to Make $10, $15 a Week Extra Fixing Sets

NRI students find it easy to start fixing sets for friends a few months after enrolling. Use the Tester built with parts NRI furnishes, to locate TV-Radio receiver troubles. Many who start in spare time, soon build full time TV-Radio businesses. Invest in training yourself—it pays big profits soon.

NRI Training Is Up-to-Date

NRI is America's oldest and largest home study Television-Radio school. More than 40 years' experience training men for success benefits you many ways. NRI methods are tested, proved. Successful graduates are everywhere, in small towns, big cities.



Technical Know-How Brings Better Pay—A stream of new electronic products is increasing job and promotion opportunities for Television-Radio Technicians. Transistor Radios, Color TV, Hi-Fi were unknown a few years ago. Guided missiles, automation, etc. would not be possible without this miracle science—Electronics.

The hundreds of TV and Radio stations on the air offer interesting jobs for Operators and Technicians.

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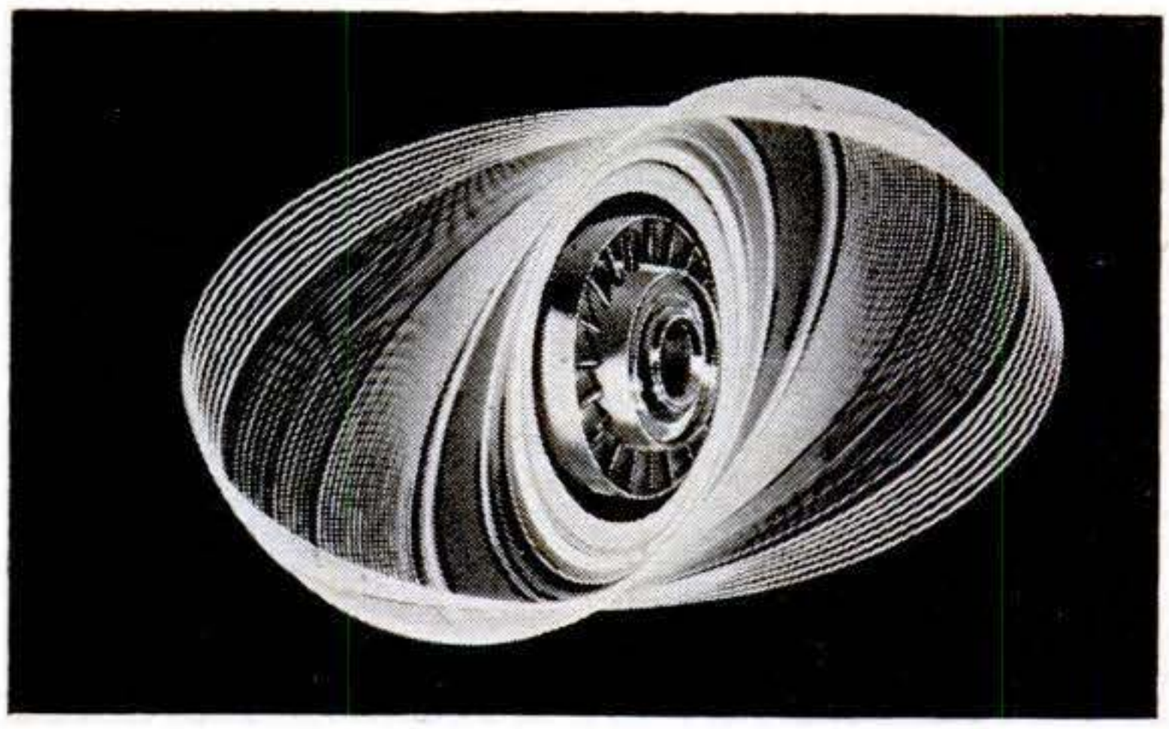
The car that uses more aircraft principles than any other land-bound vehicle yet built

When you look at that Dynastar Grille – those dual Vista-Vision Headlights—you know you're observing a completely restyled Buick.

And when you drive it, you very soon understand why it was named the B-58 Buick, after the most advanced airplane yet designed.

For this car uses more principles straight from the world of aviation than any automobile in history.

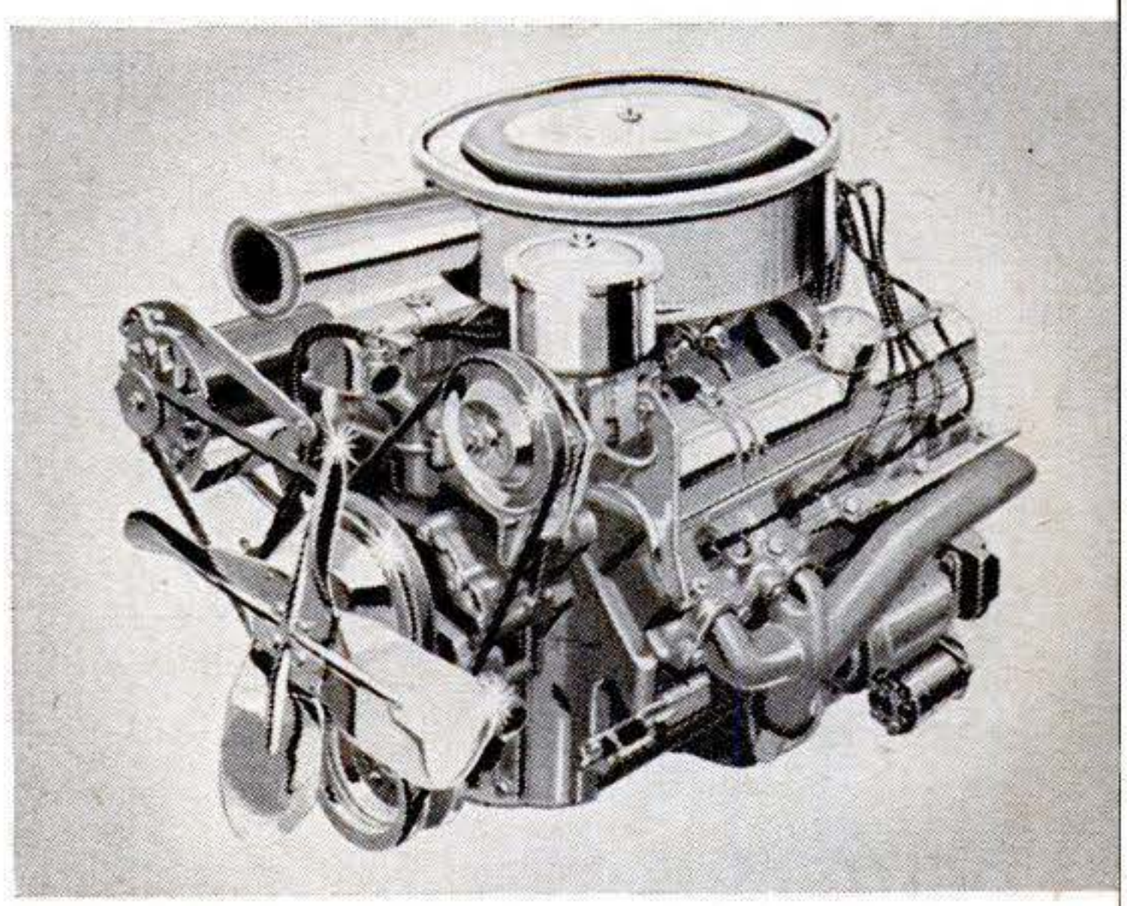


It happened that many engineering ideas that were years in development all came together in one year. And they're all here in this 1958 Buick.

Read about some of these features in this brief article. Then see your Buick dealer for a very convincing demonstration of what these features do for your driving.

1. Flight Pitch Dynaflow* Has First True, Infinitely Variable Stator – As you raise or lower your foot on the gas pedal, you automatically change the angle of the blades in this stator. You literally switch the pitch a million ways, just like today's airplane propeller. Oil, pouring through these vanes against the pump at 180 m.p.h., is redirected to suit every driving situation. You can have maximum power ratio for starting, hills, emergencies. You can have maximum economy ratio for effortless cruising. You're always in perfect pitch.

2. B-12000 Engine Develops Thrust of 12,000 Pounds Behind Each Piston Stroke—This is the most modern, the most efficient engine it is possible to build for today's fuels. Vertical-valved for compactness, this great power plant exerts a 10 to 1 compression—releases a thrust of 6 tons at each piston's power stroke. Combined with Flight Pitch Dynaflow, that results in superbly smooth and instantaneous



response – a sense of control utterly different from any other car of similar size and weight. Here is the first big car that's light on its feet.

3. Air-Cooled Aluminum Brakes* Run Cooler, Make More Quick Stops Without "Fade"—Aluminum absorbs and dissipates heat quickly – so Buick engineers built the front

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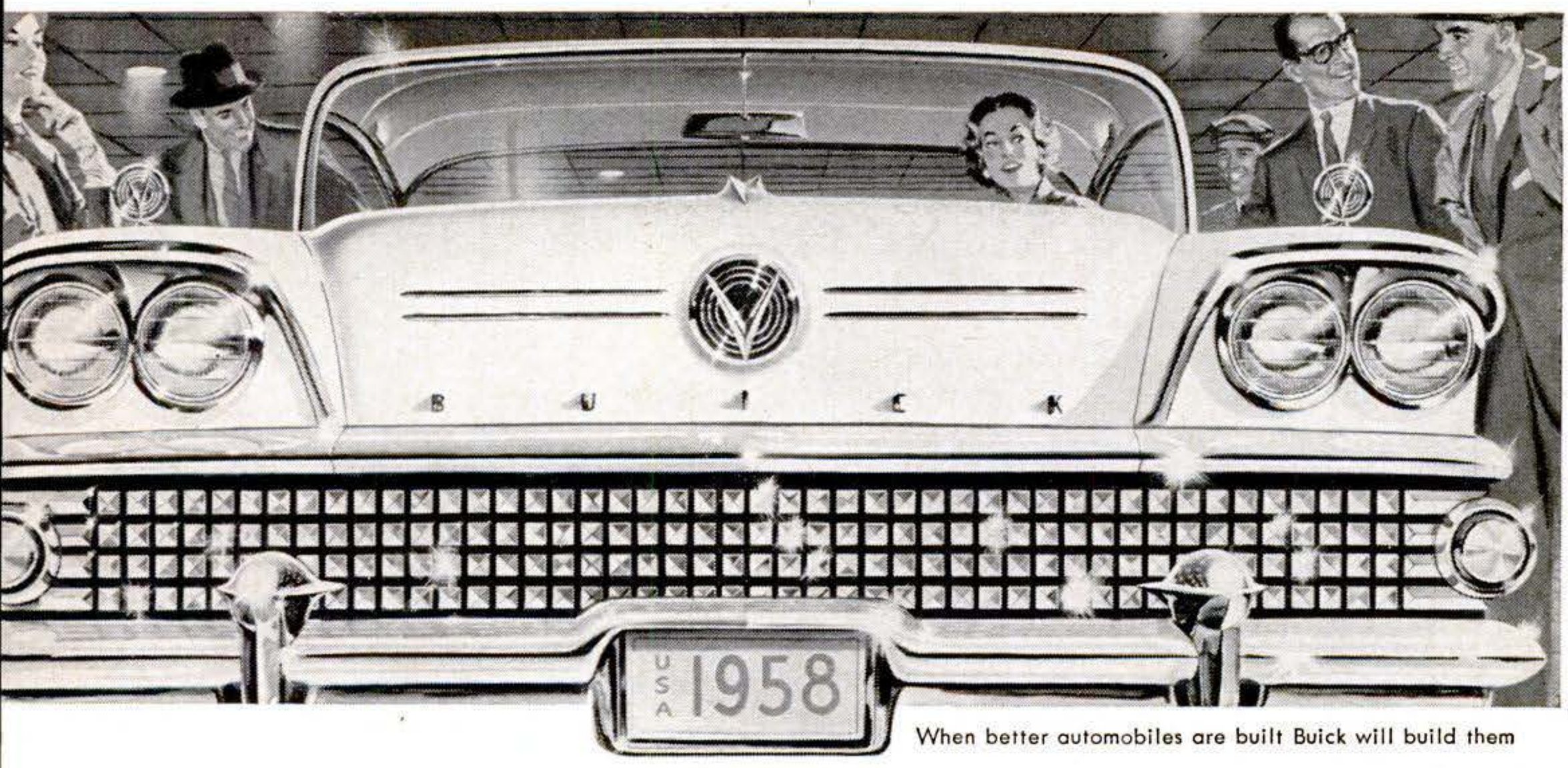
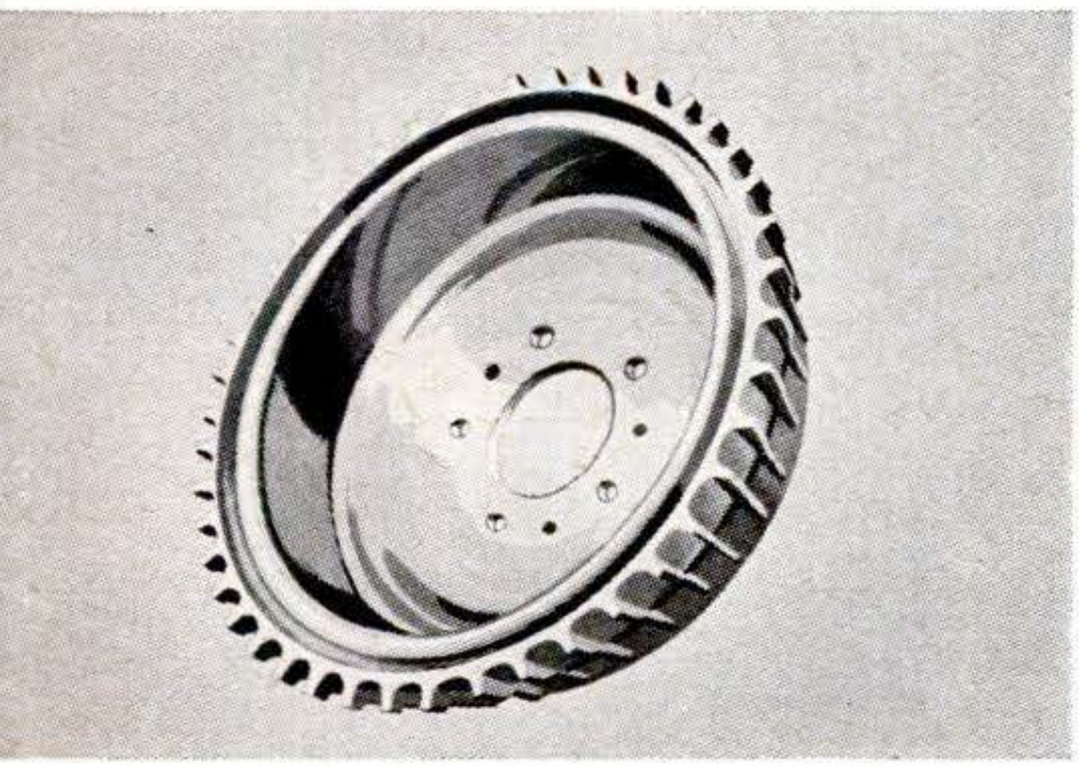
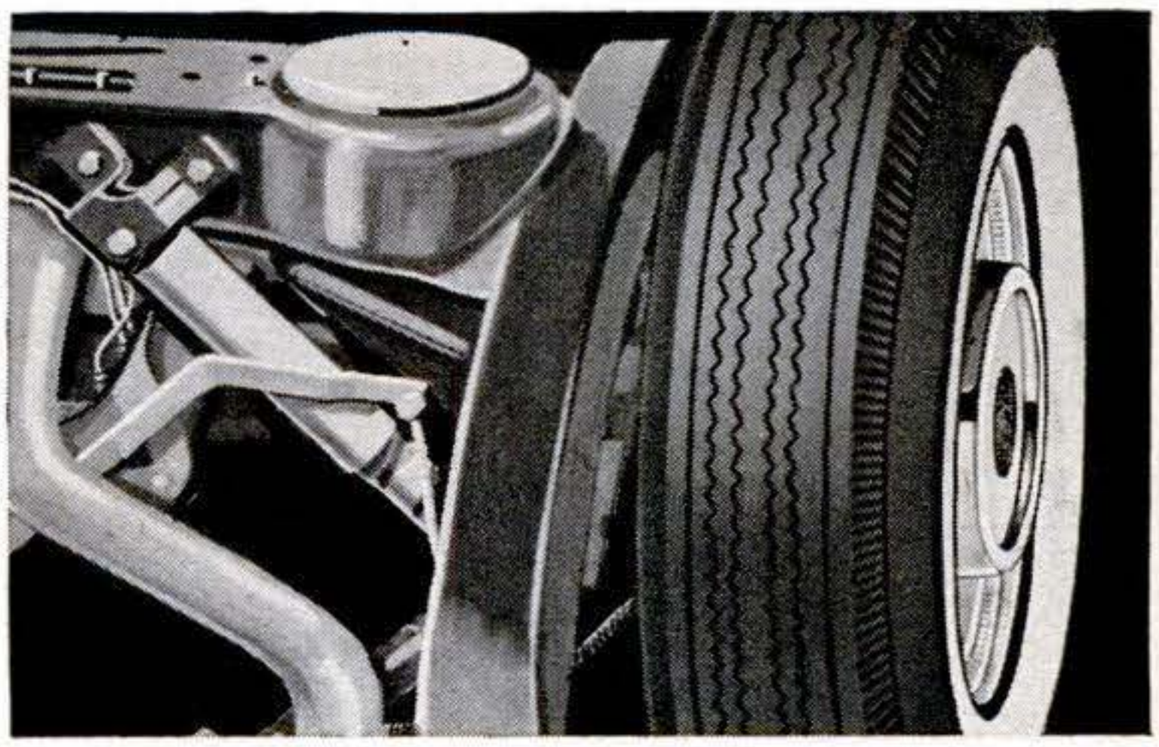


When better automobiles are built Buick will build them

rake drums of aluminum. On each drum, they esigned 45 fins, which hurl cooling air inside he brake. Still not content, they made all brake nings wider and thicker. The result: Straighter, urer, smoother braking – especially on down-rades. Longer lining-life, even in worst traffic reas.



. Miracle Ride *plus Buick Air-Poise Sus-ension Is Automatically Self-Levelizing –** uick's new ride begins with these traditional asics: X-member frame; full-length torque ube, soft coil springs at all four wheels. These, ogether with new ride improvements such as onger stabilizers and outrigger shock absorbers, roduce a thrilling new experience that well



deserves the name, "The Miracle Ride." This same basic Buick ride engineering was made to order for air suspension – makes Buick's new Air-Poise Suspension the world's finest. Four columns of compressed air (in place of the four coil springs) give you an infinitely variable spring rate – same smoothness, same "come-back," same ideal height regardless of road or passenger weight or placement. No other ride approaches it.

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The Air Born B-58 Buick

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the tube will glow if the plug is inserted incorrectly?

GERALD J. THOMAS, Detroit

Antennas Only Look Easy

SOME time back you ran an article on buying TV antennas ["New Antennas Boost TV Pictures," Mar.]. Why not go a step further and give us detailed drawings and instructions to build our own?

To keep down cost in experimental work, ¼" wood dowels might be used instead of aluminum tubing. I'm sure an efficient antenna could be built that would cut out interference, snow in the picture, and so on, yet be ornamental also.

A. H. SMITH, San Clemente, Calif.

Design and construction of a high-performance TV antenna is extremely complex. And the parts could cost more than a commercial antenna.

That Tape-Recording Bug

YOUR article on tape recorders [Sept.] certainly gave me a great deal of information on these clever machines. I am in charge of audio-visual education at Northside High School, and I've been trying to convert our English teachers from less durable records to tapes. You mention over 1,100 available selections—from bebop to dramatic readings. Can you refer me to sources?

My wife and I have been debating the merits of buying a new record player. After reading the article, I think she is weakening in the direction of a tape recorder.

H. M. WILLIAMSON, Corning, N.Y.

A catalogue of pre-recorded tapes is published by M & N Harrison. Inc., 274 Madison Ave., NYC 16. The price is 25 cents.

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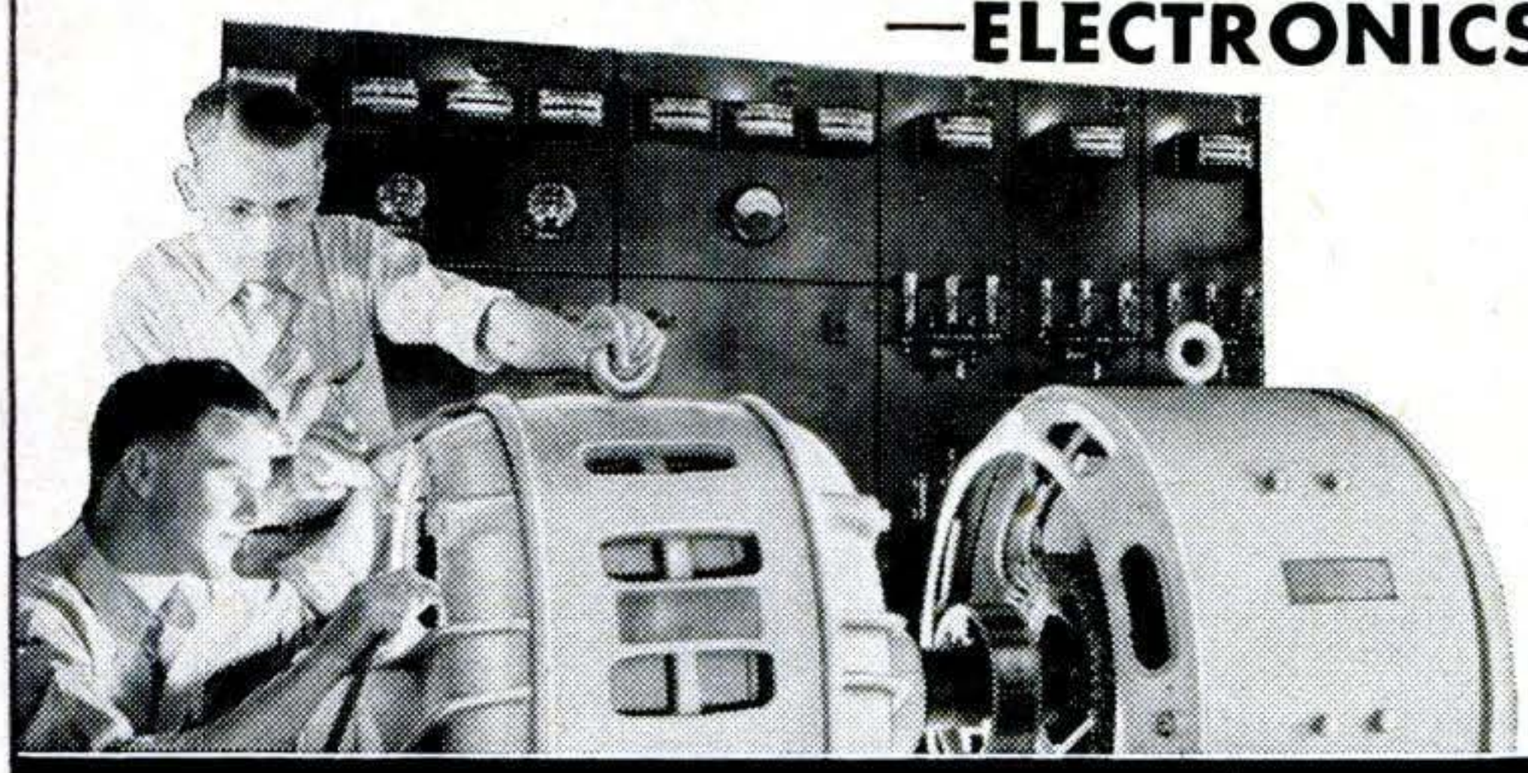

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CONTROLLERS
WIRING JOBS
APPLIANCES
ELECTRONIC UNITS

(Shown at left—Instructor explaining operation and testing of a large Motor Generator in our A.C. Department.)

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On Real:

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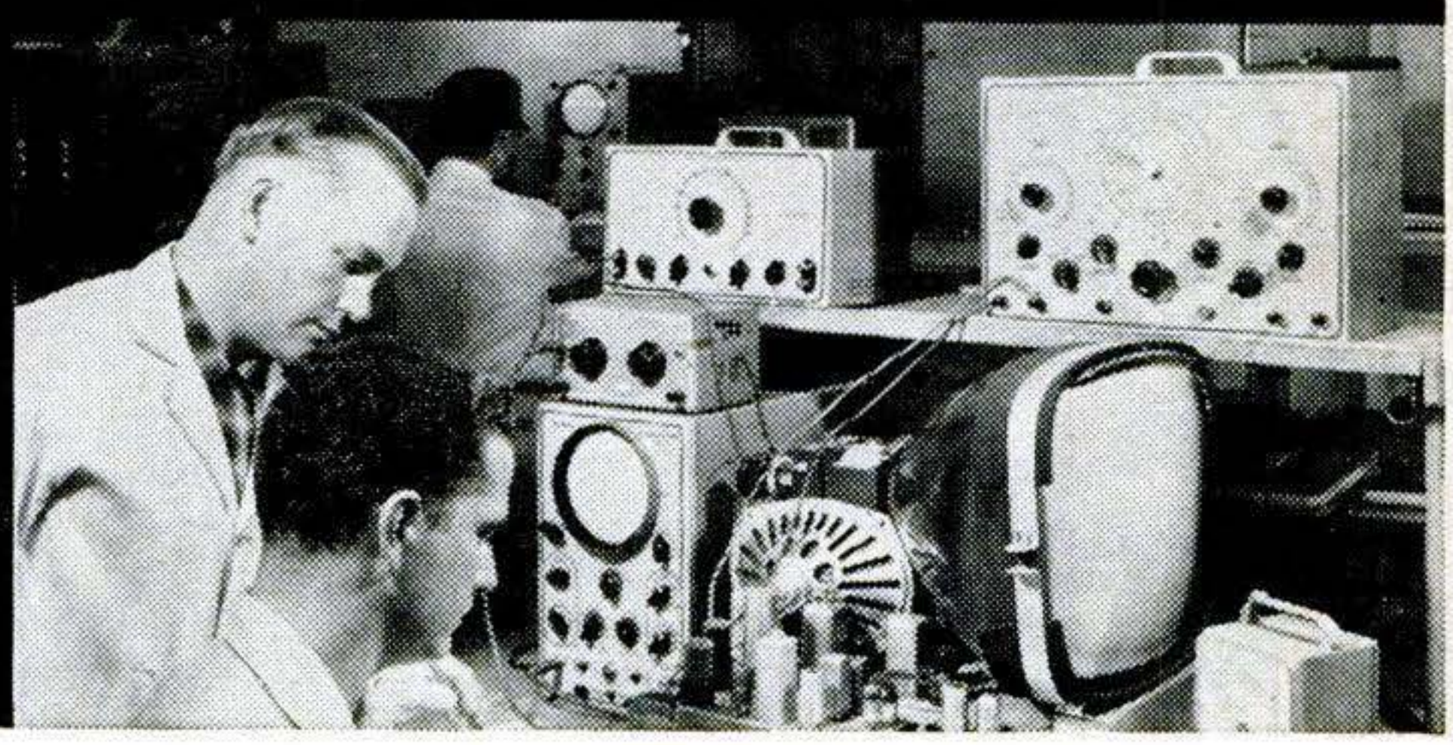
AM and FM RADIO RECEIVERS including AUTO RADIOS
TELEVISION TEST EQUIPMENT

(Right — Instructor helping students check the wiring and trace circuits of television receivers.)



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Keeping the Home Shipshape

GUIDE VISITORS TO YOUR HOUSE at night by putting a lamp in the window with your street number on it. Colored tape on a parchment shade can easily be stripped off later.

PROTECT TABLE TOPS with scraps of linoleum. Cut into circles and oblongs, they make handy coasters when coffee is served in the living room. Put them under flowerpots, too.

TO KEEP A CHRISTMAS TREE GREEN, give it a wick so it can drink more water. Bore upward into the trunk as deeply as possible and then pack the hole with absorbent cotton.

LIKE FRESH AIR AT NIGHT? You'll have lower fuel bills and a warmer house mornings if the bedroom door has a weatherstripping arrangement that drops a felt seal as the door is closed.

A HEATING PAD IN YOUR KITCHEN can come in handy. Folded, it makes a miniature warming oven for such jobs as taking the chill off dinner plates, crisping cereals or heating rolls.

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Prize Projects BY PS READERS

Refreshment Wagon. A plywood bin and a shelf with circle cutouts keep bottles and glasses from sliding on this lightweight, two-wheeled serving cart built of birch by Ralph Treves of Jamaica Estates, N.Y. The flat tray is big enough to hold a water jug, ice bucket and canape plates. The legs and crossties (supporting the tray) pivot on dowels so that the cart can be folded up for easy storage when not in use. Although he could have used 5″-diameter stock wheels, Treves cut his own on a jigsaw. Dowels serve as the axle pins.

'51 Ford Fancied Up. A Thunderbird windshield accents this sports car put together during 2½ years of spare time by Carl Roehl in his Appleton, Wis., "frame-and-front" shop. The 1951 V-8 engine, moved back 22″, has high-compression heads, a four-barrel carburetor, dual exhaust pipes and Magspark ignition.

Pipe Dream Come True. The huff-and-puff smoker often is also a collector of pipes. But keeping his smoking gear neat was a problem for Joe Fletcher of Chicago until he built this giant rack of ¼″ plywood and installed it in his den. It is 36″ wide, 24″ high, and has 56 compartments arranged in four tiers. The pipe pockets increase in height from top to bottom, and each pocket is lined with pool-table felt.

Have *you* recently completed a workshop project of which you are particularly proud? Send a good photograph of your work, along with the negative and a brief description, to the Mechanics and Handicraft Editor, POPULAR SCIENCE, 353 Fourth Ave., New York 10, N. Y. We will pay $15 for each item that is accepted for publication.

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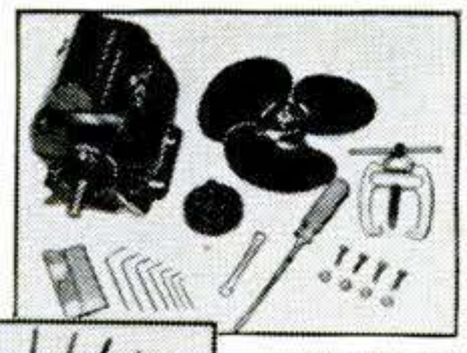

You build a heavy-duty, commercial-type, ¼ h. p. compressor (above). You assemble this unit in easy stages with kits that CTI sends. At left are photos of just two of the 23 kits. One shows mechanic's tools; the other depicts a motor, fan, pulley, other service tools. CTI practical training kits develop skill, provide experience, speed training!

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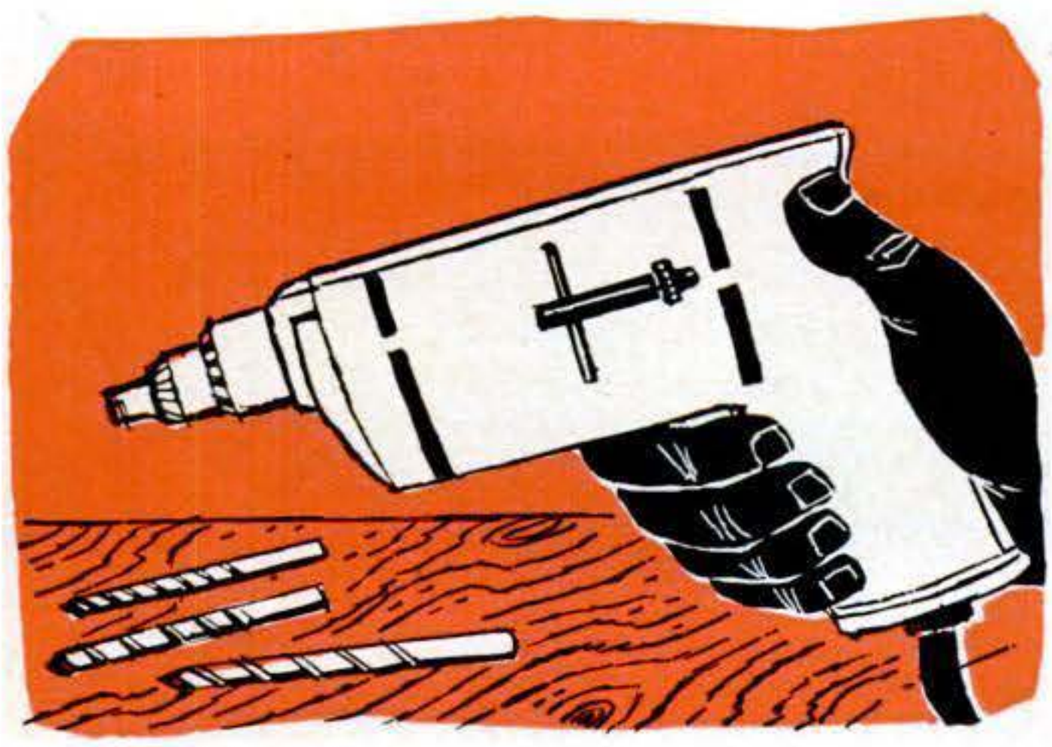
"I'd like to see them make..."

CHRISTMAS-SCENE STENCILS to make stained-glass picture windows. The black outlines of the stick-on stencil would be filled in with colored cellophane or plastic wrap.—*J. Moon, NYC.*

A REVOLVING ELECTRIC FRYER to eliminate standing by and turning food to prevent burning. It should lift off the motorized stand for washing. —*Raymond A. Thomas, Burbank, Calif.*

ICE MELTERS for stuck cars. Short flexible pipes on a dual-tailpipe system would expel heat when the driver opened butterfly valves from the dash.—*F. J. Morgan Jr., East Liverpool, Ohio.*

BUILT-IN TOOTHPASTE-TUBE CAPS. Why not lengthen the neck of the tube and put the hole at the side? A few twists of a threaded collar would open the tube.—*Bernard Gold, NYC.*



KEY-KEEPERS ON ELECTRIC DRILLS. A magnetized pocket in the housing would eliminate the search for the chuck key every time you put it down.—*A. R. Peery, Harlingen, Tex.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE readers. What is *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

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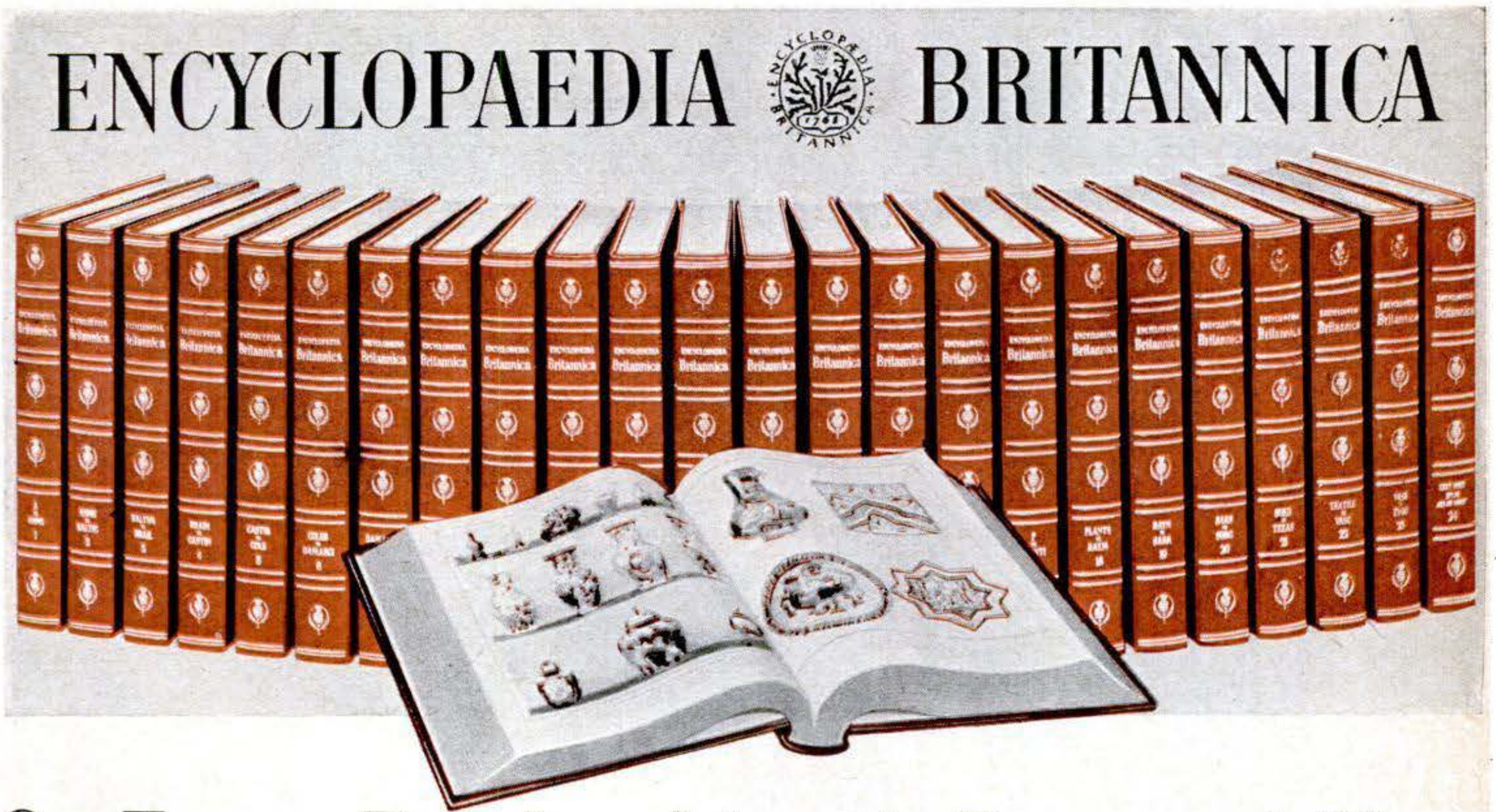

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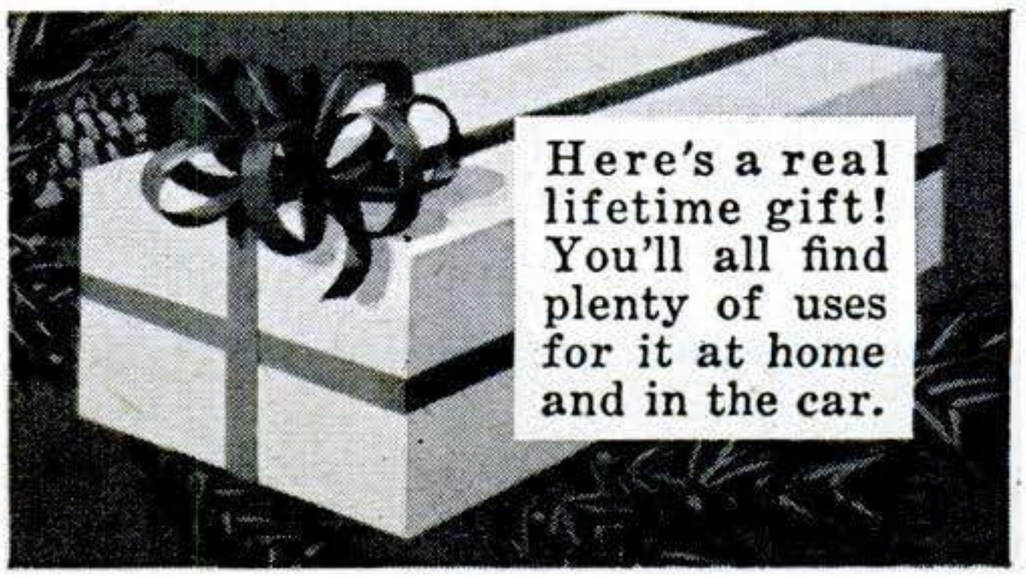

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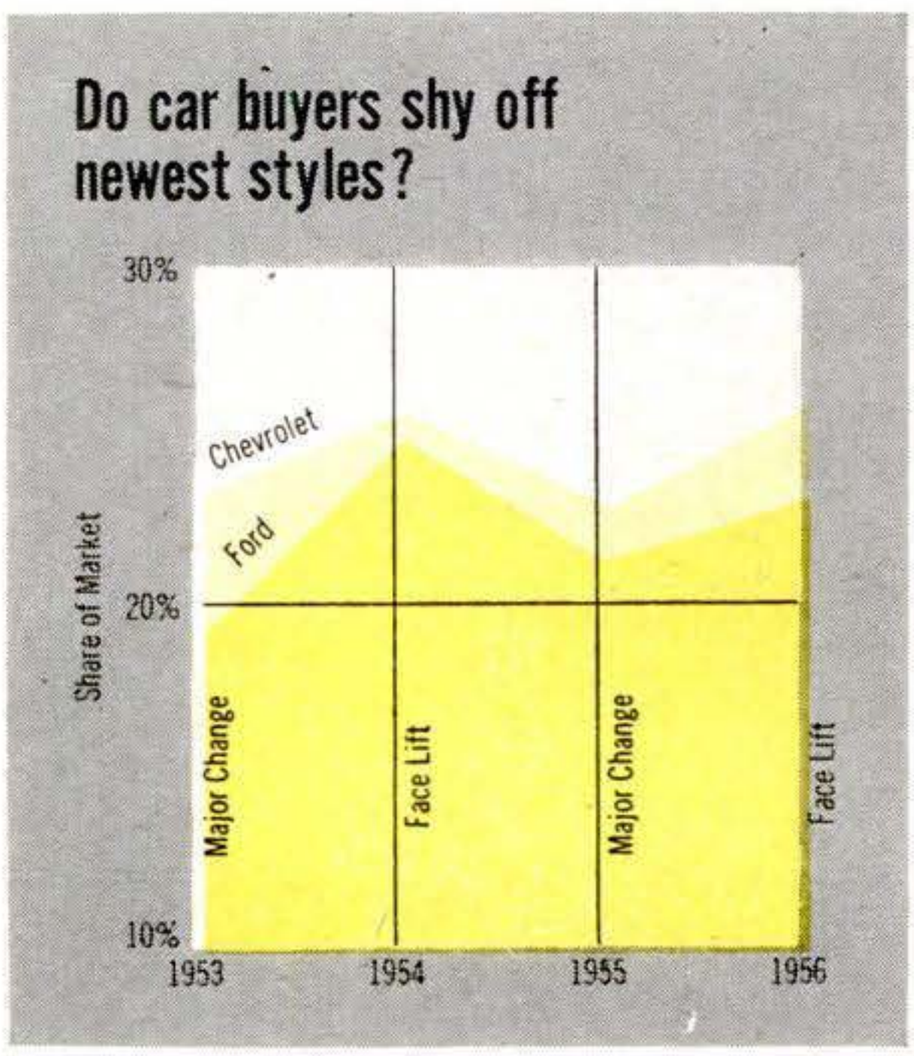
You ought to know...

Will Plymouth's face-lift-only hurt its popularity? Maybe. Chrysler cars have sold best the year a major change was made.

With Ford and GM, the opposite is true. Each has increased its share of the new-car market the year *after* a major change (the face-lift year), as the chart shows. If the Ford-GM pattern holds, Buick won't stand a chance of taking back the Number 3 spot in sales from Plymouth until 1959. And by then there'll be an all-new Plymouth to beat.



The cake-frosting lure of extra options is the rule for '58 on all cars. Some recently reported items:

- The Auto Pilot for Chrysler and Imperial, to hold speed steady up and down hill on turnpikes.
- FM radio on one luxury car now; on many by 1960.
- Air suspension (rear wheels only) on Ambassador and Rambler, which thus join the "pressurized-bag" parade. Will such tidbits sell cars? Automobile manufacturers are betting heavy money that they will.

The furor over radioactive fallout is boiling up again. Scientists and statesmen are worried. Said the U.S. Congress Joint Committee on Atomic Energy, hardly an alarmist group:

"Further testing [of atomic weapons] over the next several generations at the level of testing of the past five years could constitute a hazard to the world's population."

What to do about it? Hoping to cut down on atomic explosions, we'll continue to try for international agreements, no matter how tough the Russians are to deal with.

Here at home, meanwhile, look for new—and lower—limits on "permissible radiation," the amount of radioactivity that scientists figure you can safely take. For example, expect these changes:

Physicians and dentists will become much more guarded in their use of X rays. Your doctor will avoid them for diagnosis (particularly if you are under 30), unless no other method will do. Doctors will get new equipment—higher voltage, better shielding—and will check it frequently for leaks. You'll wear

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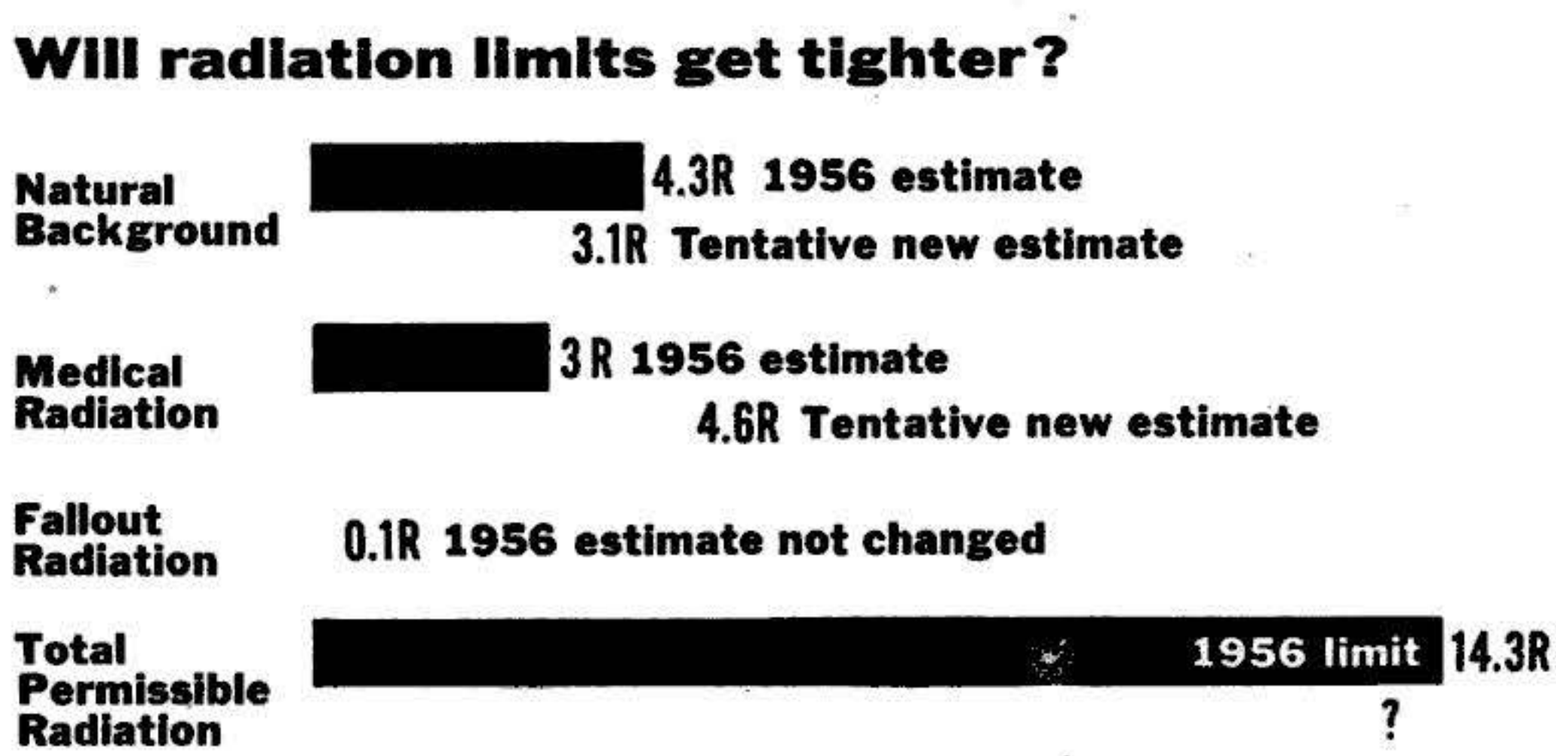
You ought to know...

a lead-and-rubber apron for practically all X rays, even when the dentist X-rays your teeth.

Some new and disquieting measurements of atomic radiation and its effects are behind the fuss. Two factors:

1. Human cells seem more easily hurt by radiation than had been thought. They may be so sensitive that natural background radiation alone (from cosmic rays and radioactive materials) could emerge as a chief cause of the hereditary defects that handicap mankind. This means that a slight increase in radiation—from any source—could cause serious harm.

2. Exposure to medical radiation is higher than had been thought—probably, on the average, by a good half. If the first



point above is substantiated, it will mean that medical radiation may already be increasing the number of defectives. No one is sure. We're trying to find out—fast.

This looks like a good time for building or remodeling, as PS predicted it would be earlier this year. But not unless you have socked the cash away (you'll find it hard to borrow).

The tight-money policy has sharply cut regular home-building. The first half of '57 was well below '56.

Prices of some building materials have dropped, as one result. Lumber, millwork, plywood, plumbing equipment are all cheaper. Wallboard is about the same. But concrete, roofing, glass and paints are higher. Labor costs are up, too, although you should have no trouble finding people to do your work. Best way to save, of course: Do it yourself.

Kids plaguing you with questions about satellites? They can get the answers themselves from a sprightly and informative new book, *Space Satellite*, written by Lee Beeland, of the POPULAR SCIENCE staff, and Robert Wells ($2.95, Prentice-Hall).

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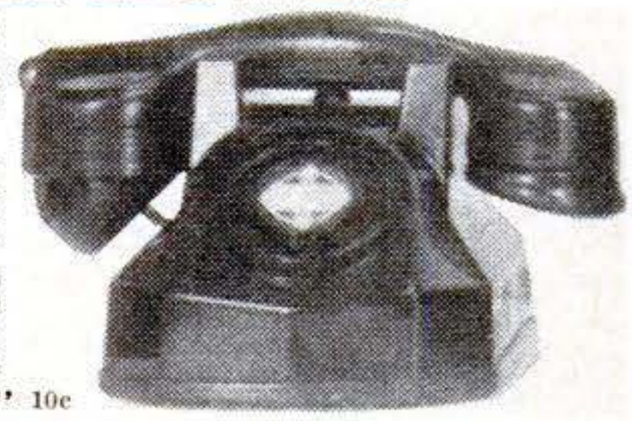

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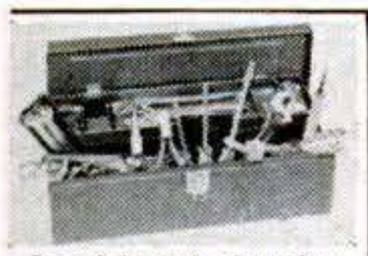

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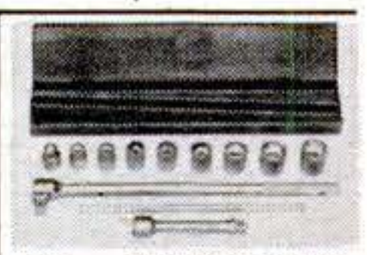

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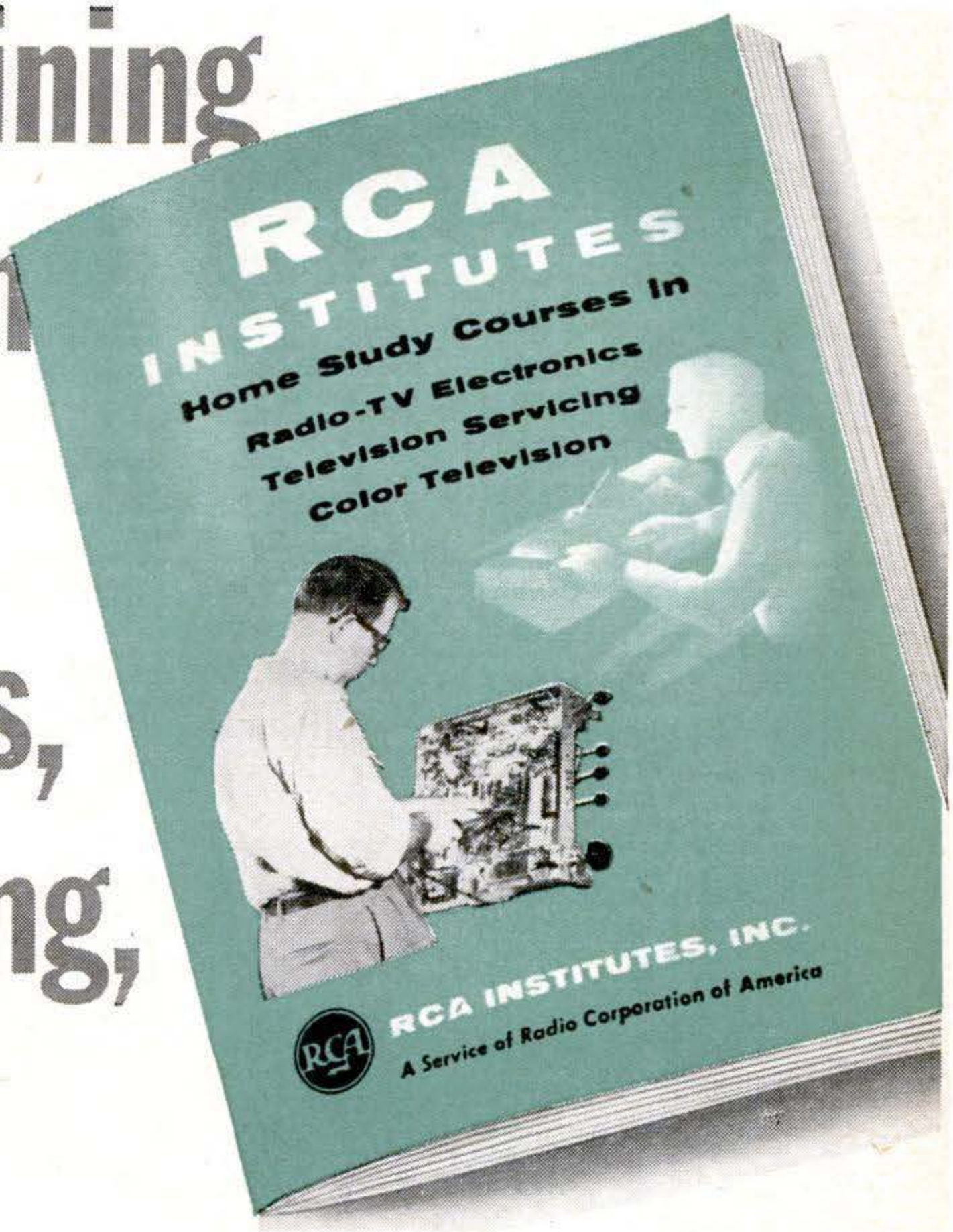

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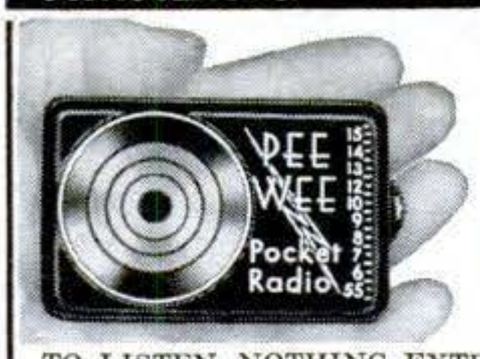

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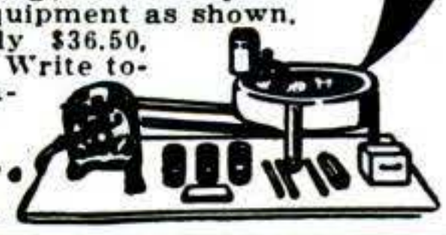

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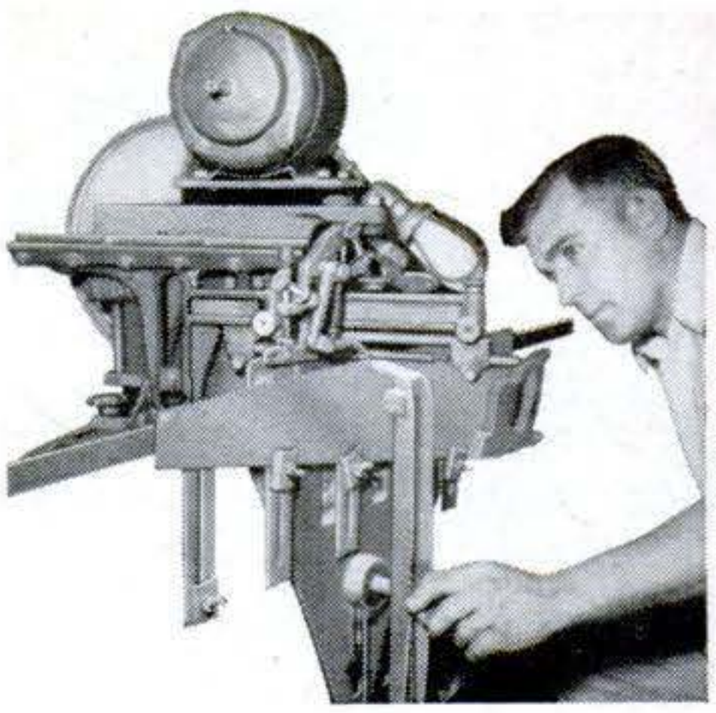

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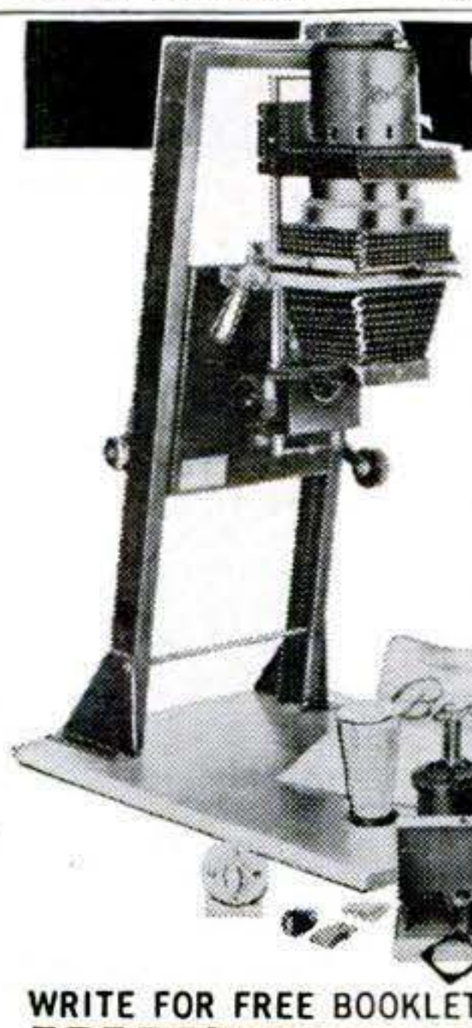

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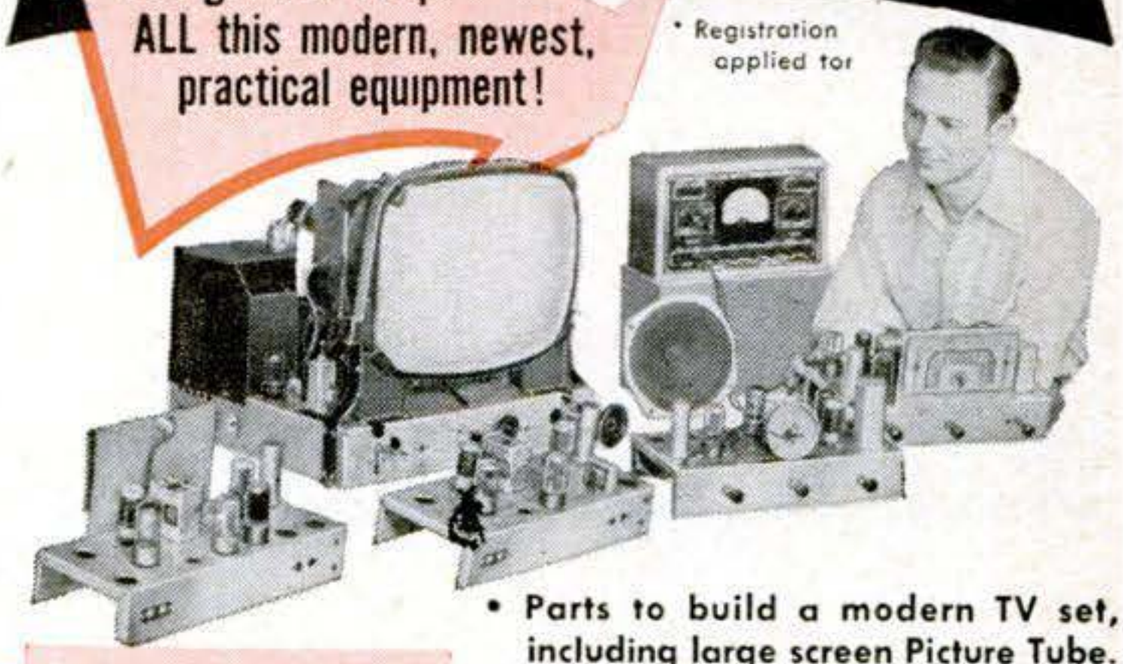

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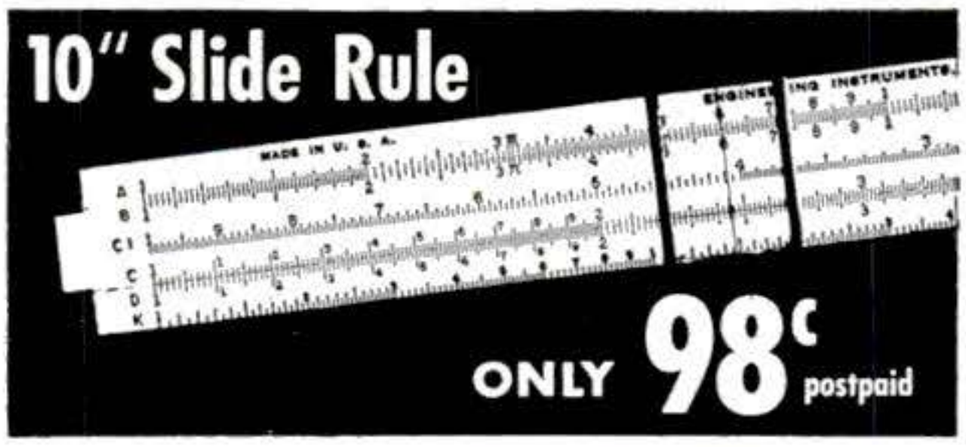

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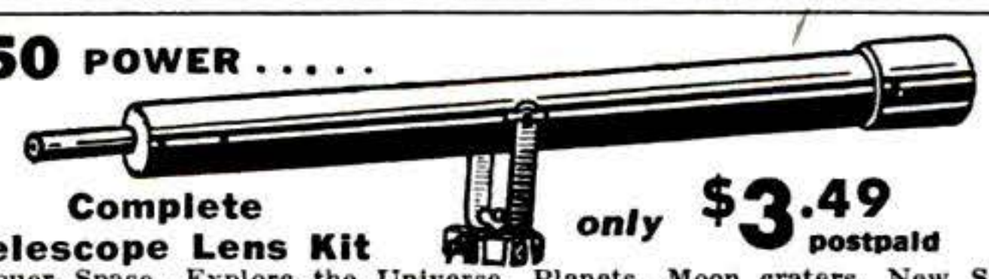

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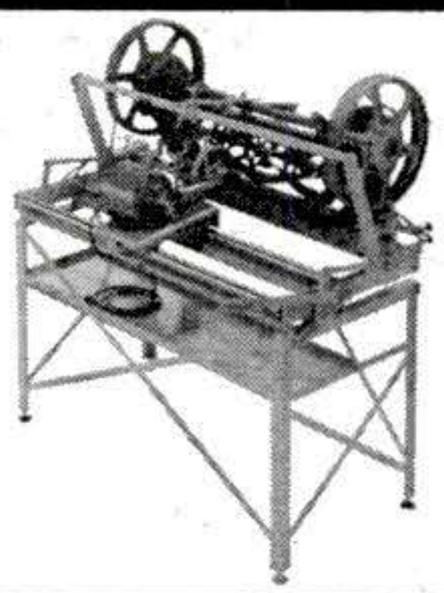

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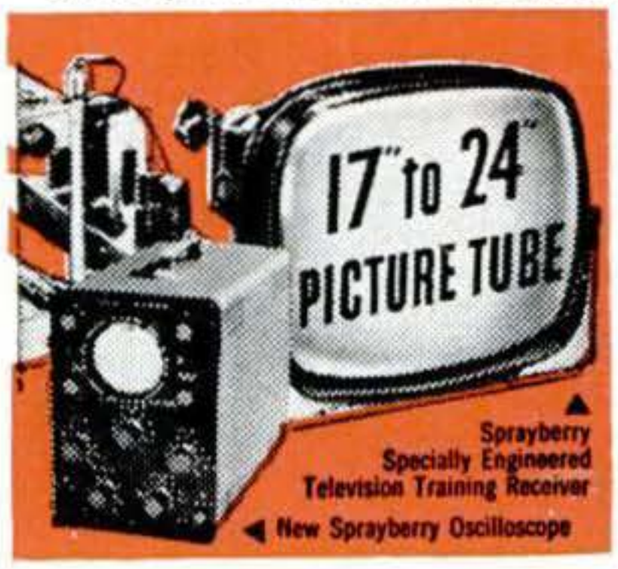

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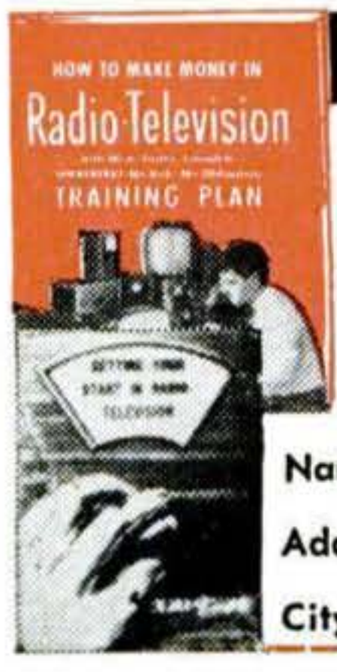

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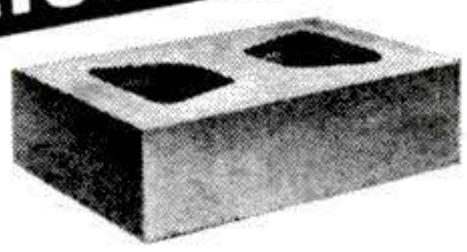

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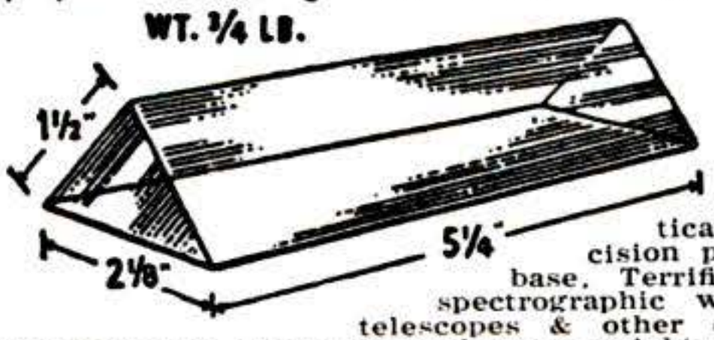

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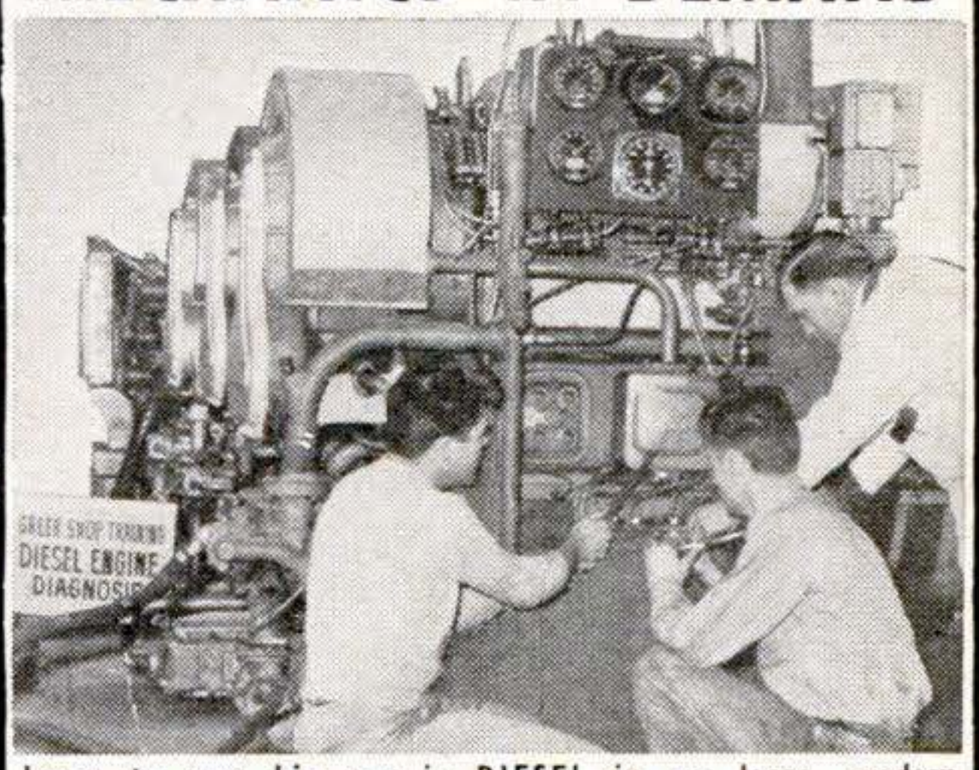

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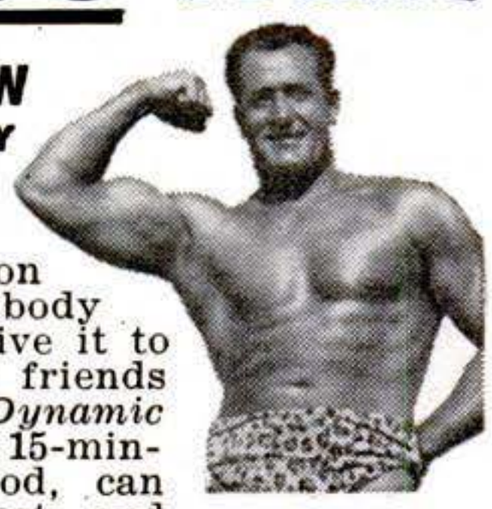

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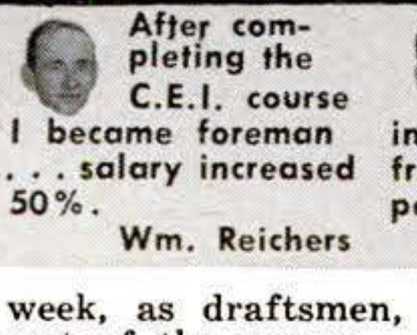

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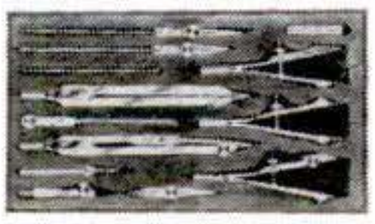

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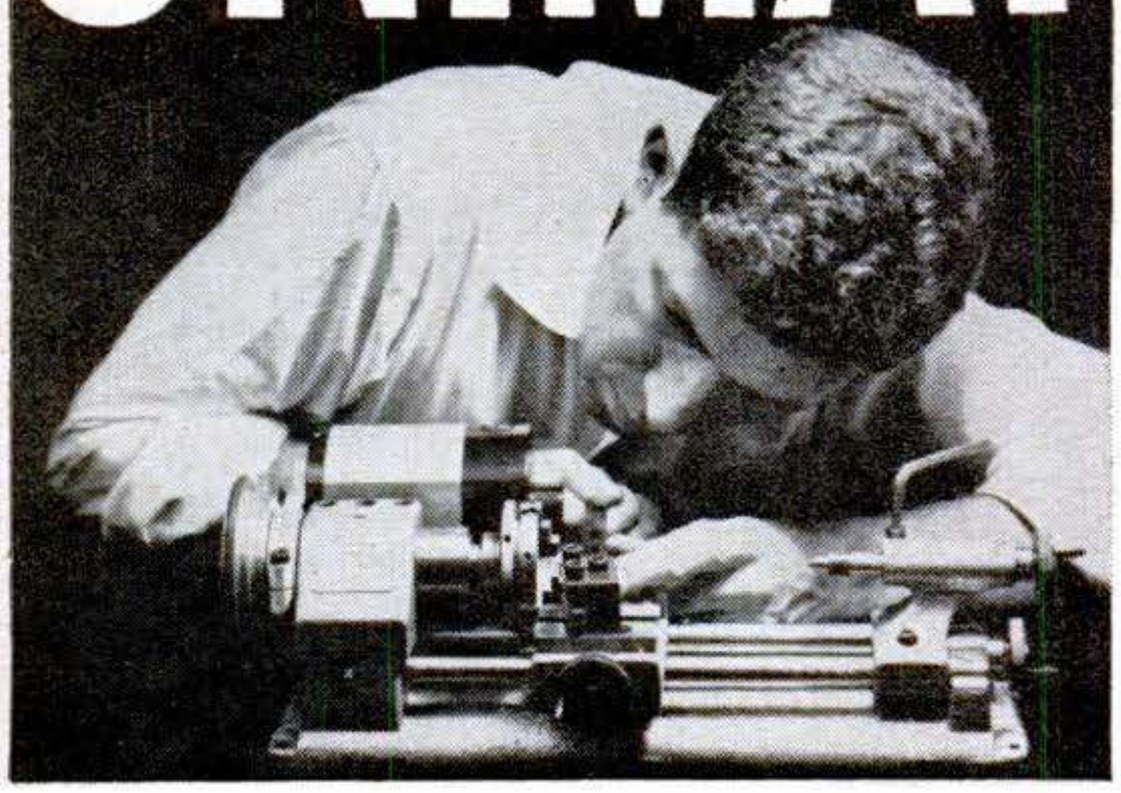

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700-16	6.25	800-15	5.75	650-20	10.75	1000-20	17.95
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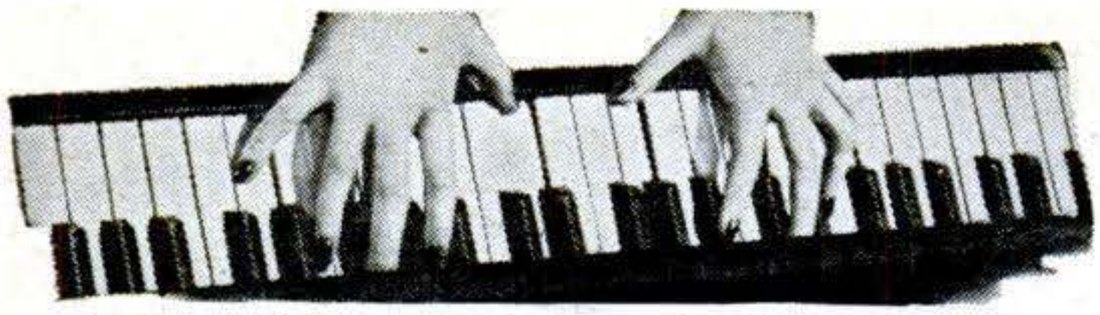

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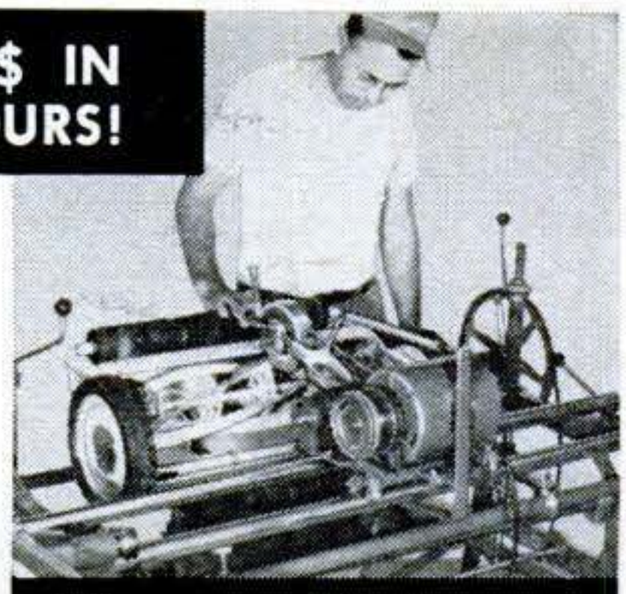

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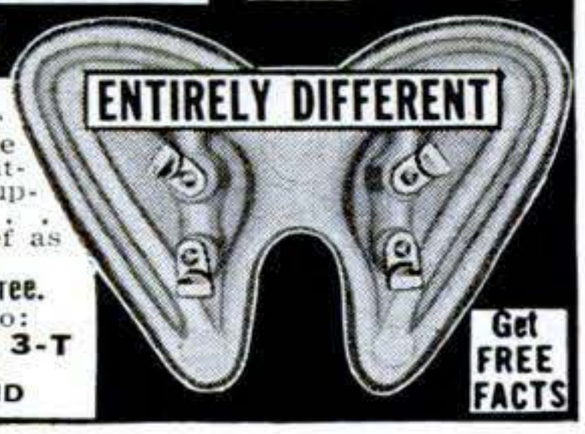

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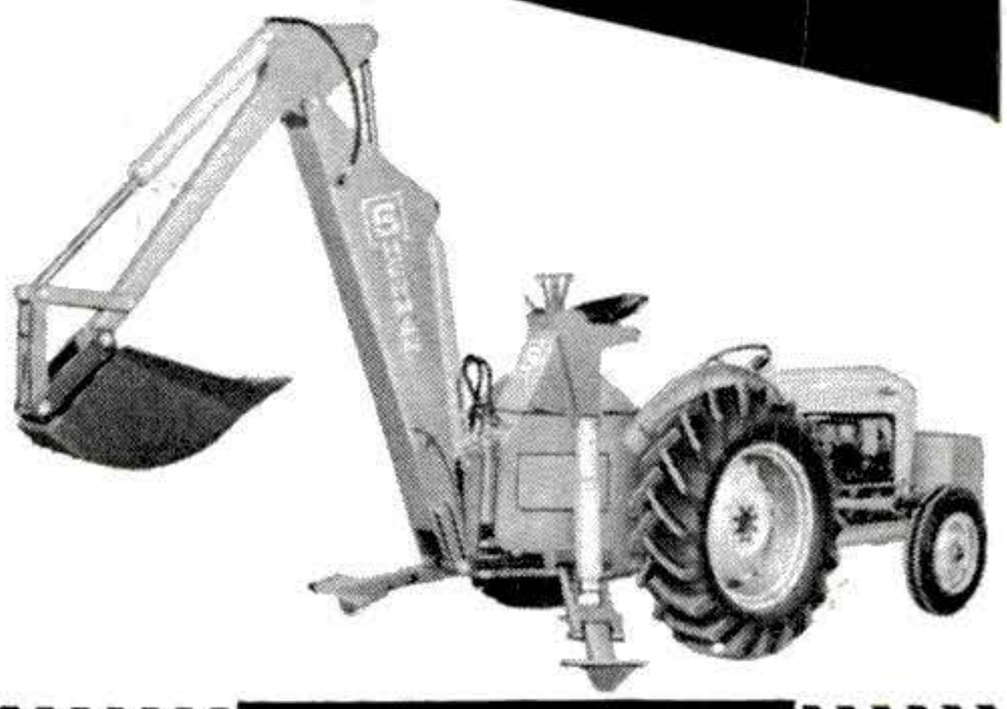

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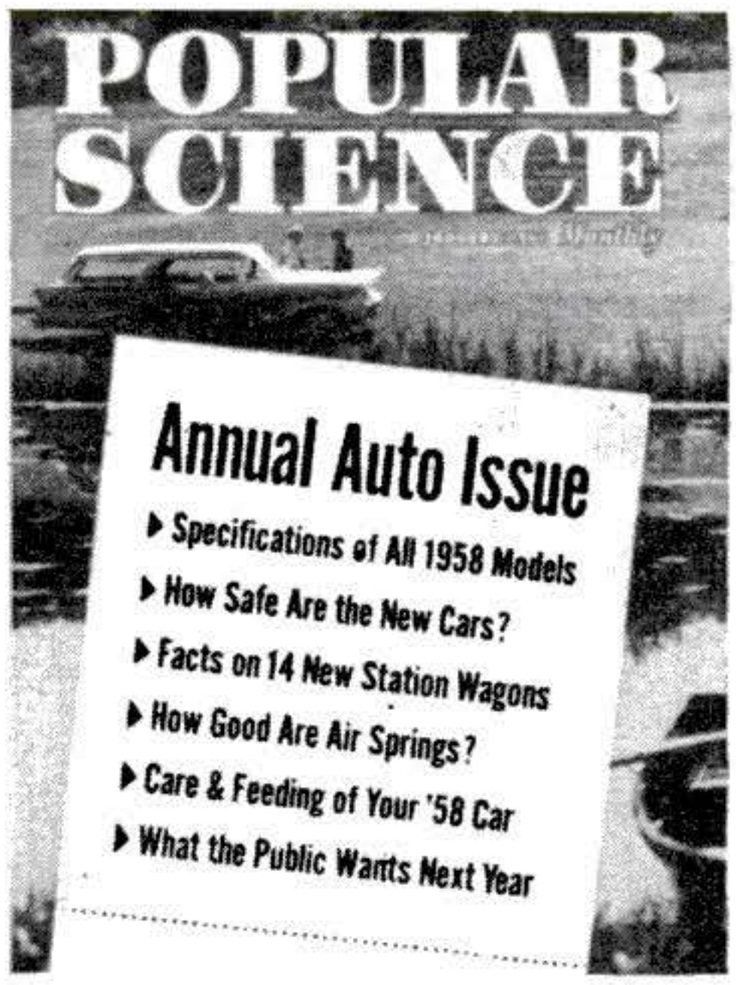

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HOW GOOD ARE AIR SPRINGS?—The hottest innovation on the '58 cars is air springing, and January POPULAR SCIENCE brings you all the inside data. You'll see a detailed specification chart that compares the air-spring systems of every major-make car that now offers it. You'll get the answers to: Are air springs really better, or are they just a sales gimmick? Why are they so popular so suddenly? How do they work? What are the special service problems of air springs? What are their particular advantages? Disadvantages? How does it feel to ride on air springs?

FACTS ON 14 STATION WAGONS—Page after page of superb, full-color photos of station wagons by Pontiac, Chevrolet, Oldsmobile, Buick, Studebaker, Ambassador, Ford, Edsel, Mercury, Plymouth, Dodge, Chrysler, De Soto, Rambler. You'll also get a handy comparison chart showing all the vital statistics for all 14 wagons. For instance, you'll see how the dimensions of a Ford cargo compartment compare with those of a Chevy. You'll learn the cubic capacity of a Plymouth wagon compared with a Buick. You'll see at a glance the number of seats, width and height details, number of passengers, etc., for each of the 14 wagons.

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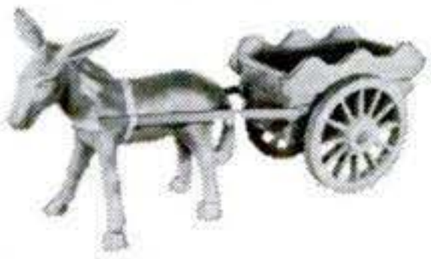

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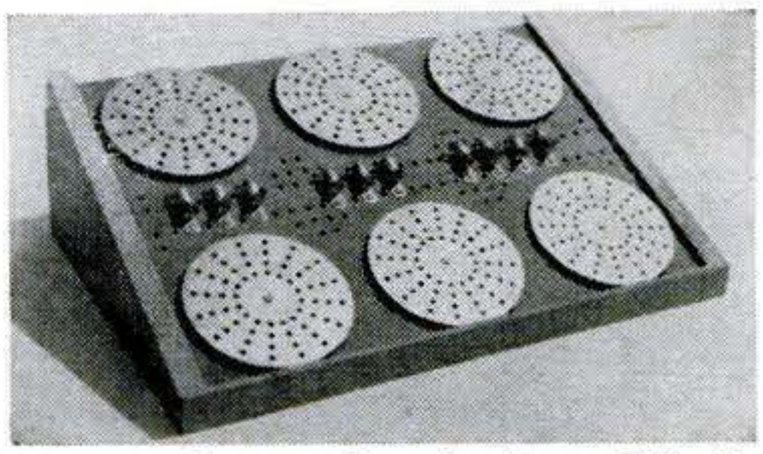

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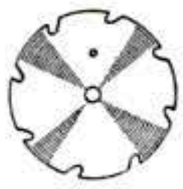

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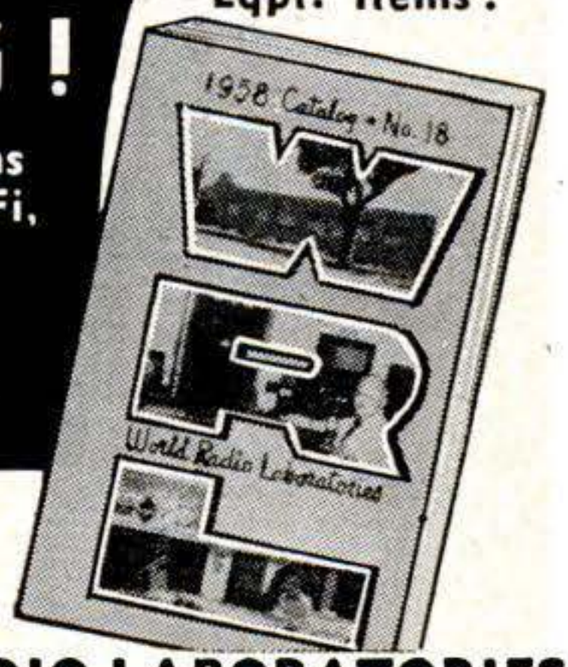

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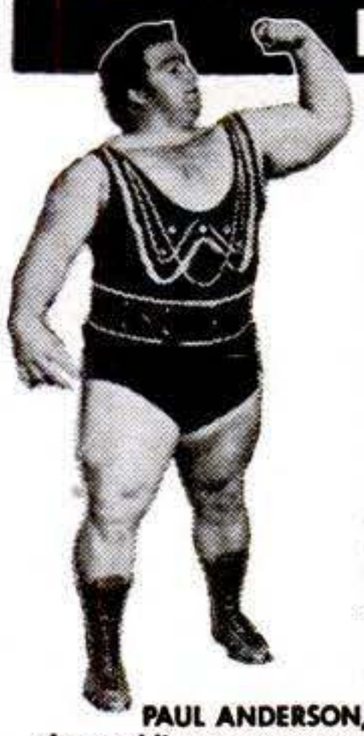

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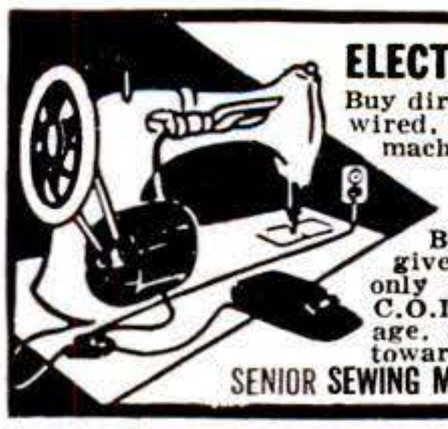

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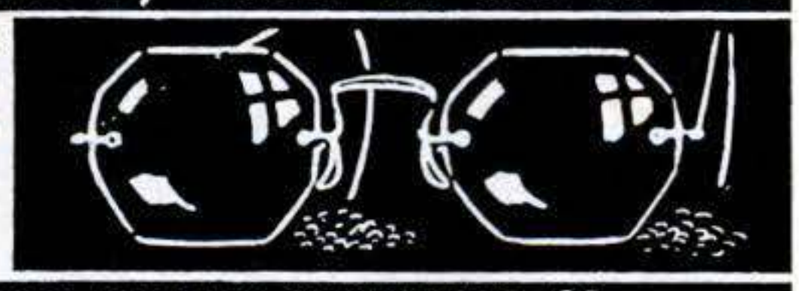

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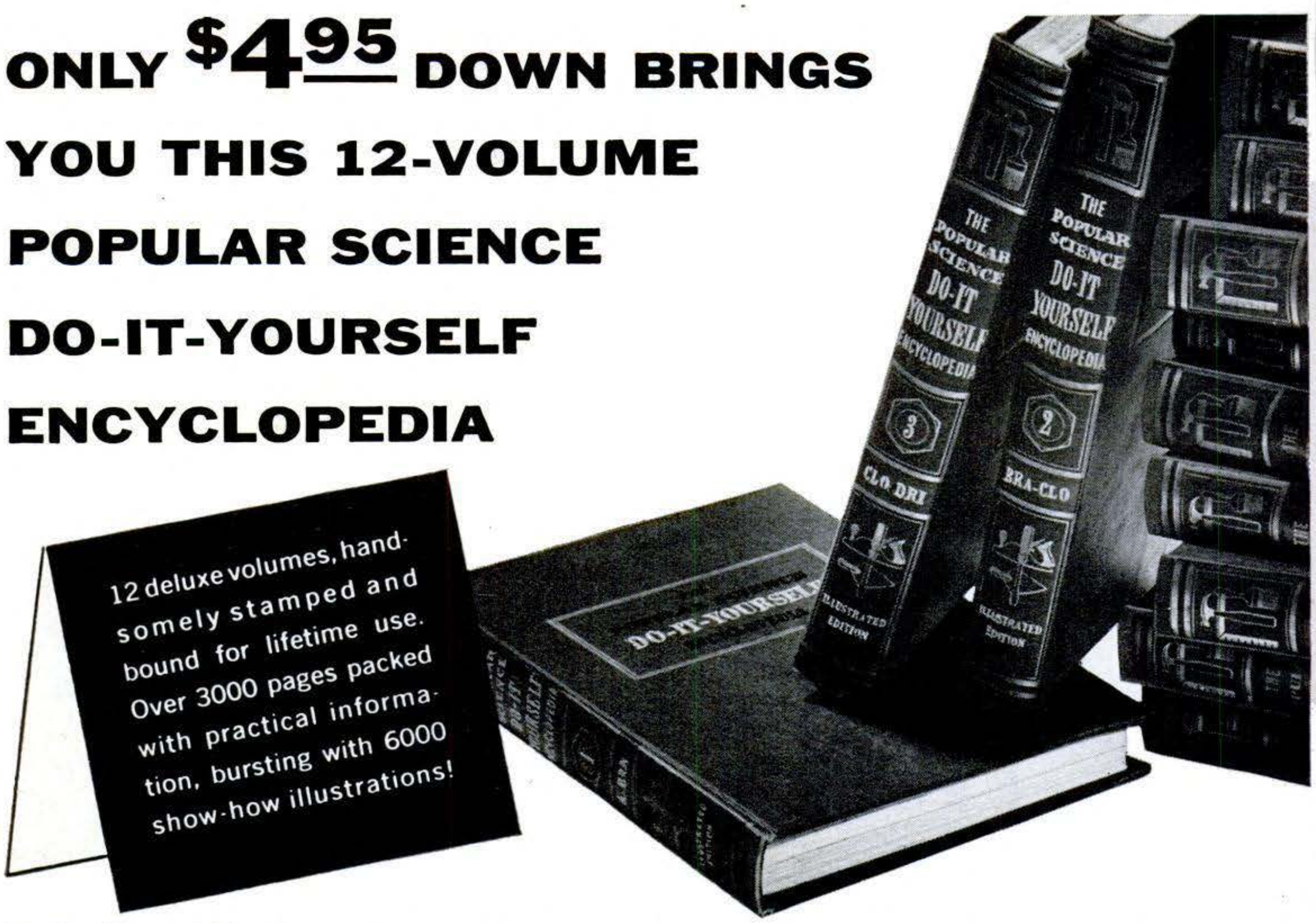

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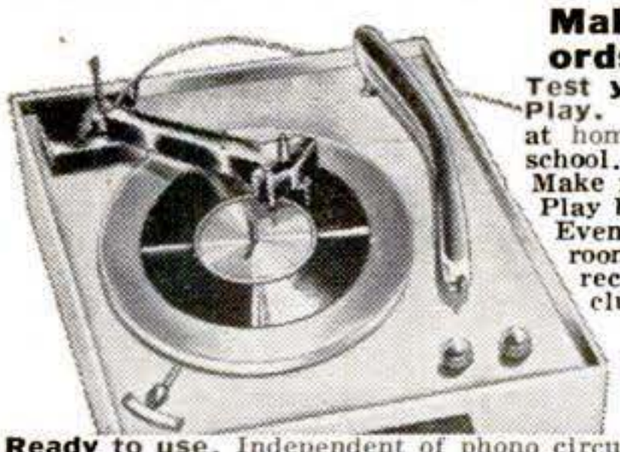

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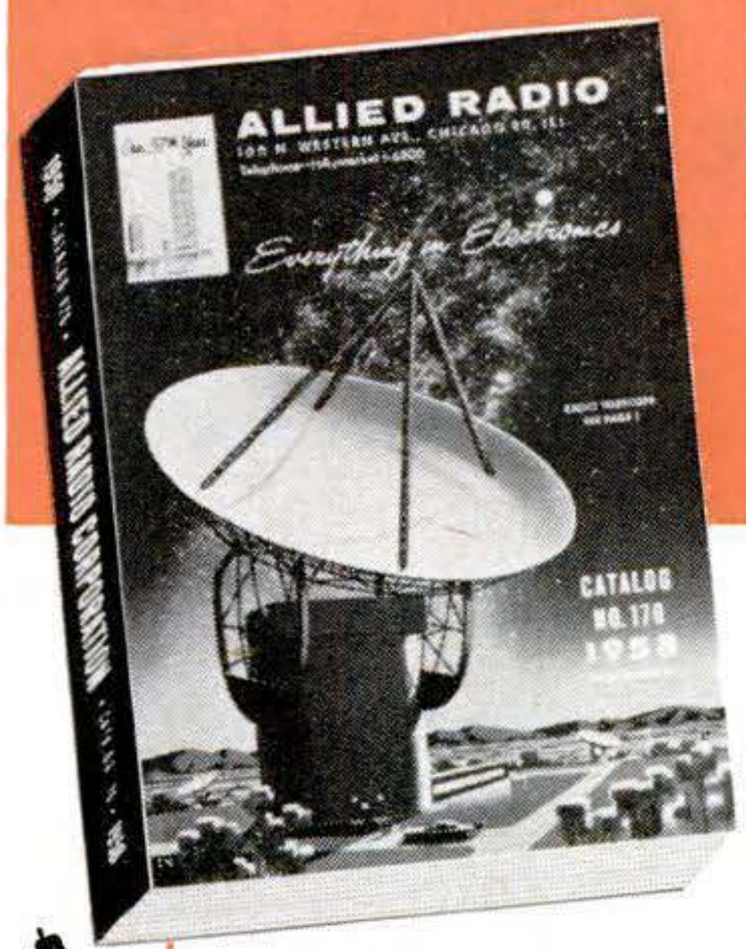

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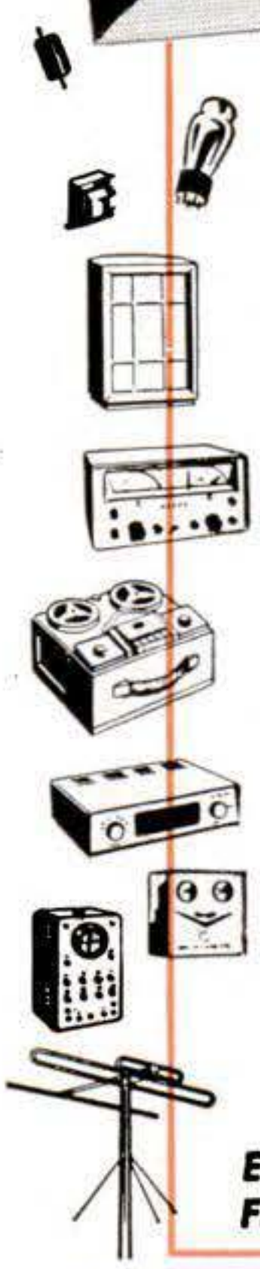

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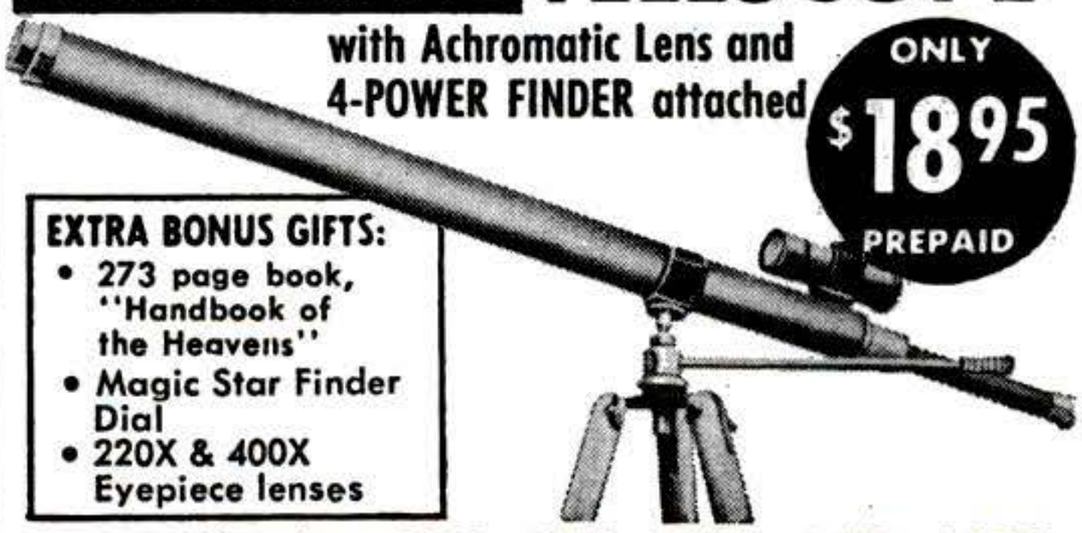

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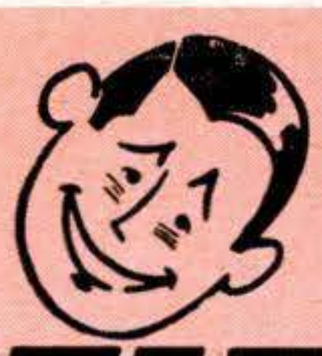

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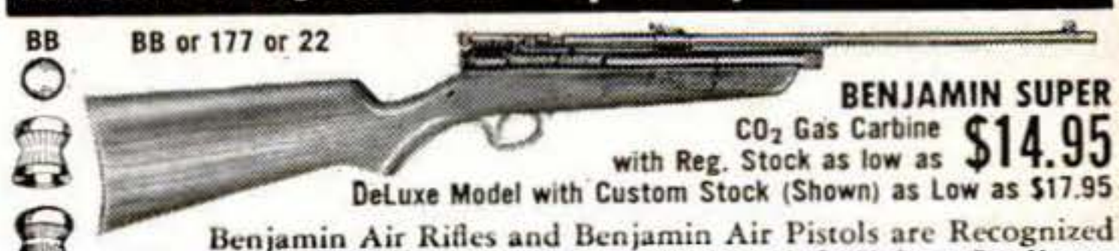

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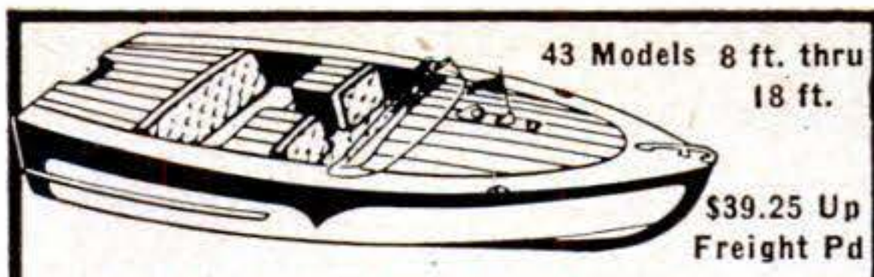

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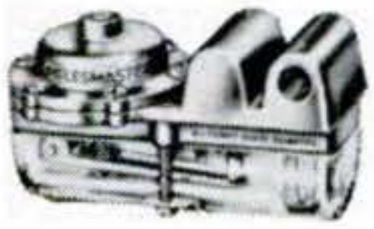

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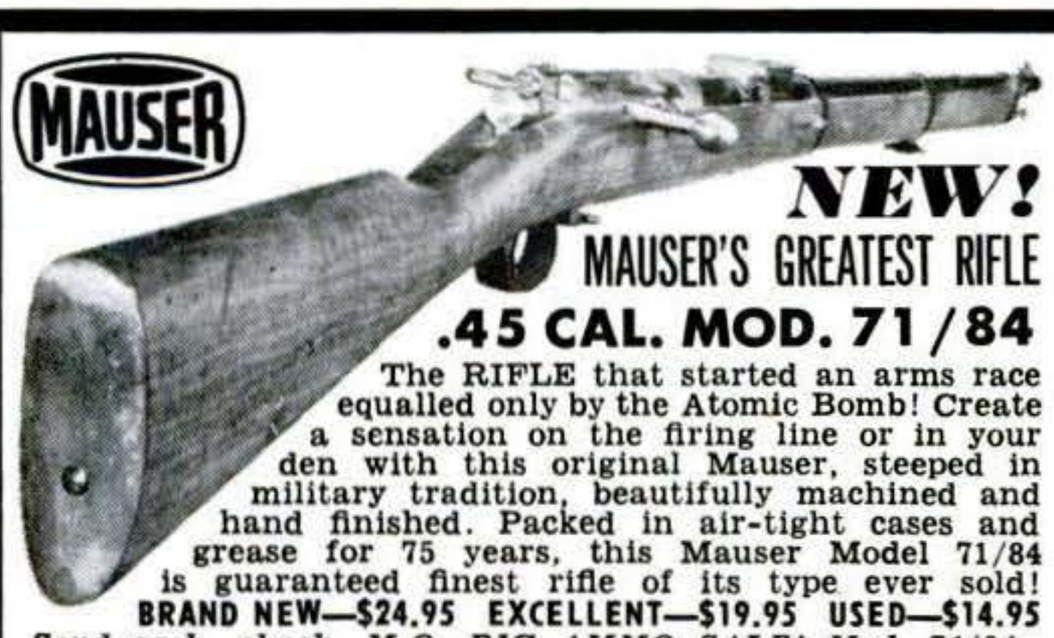

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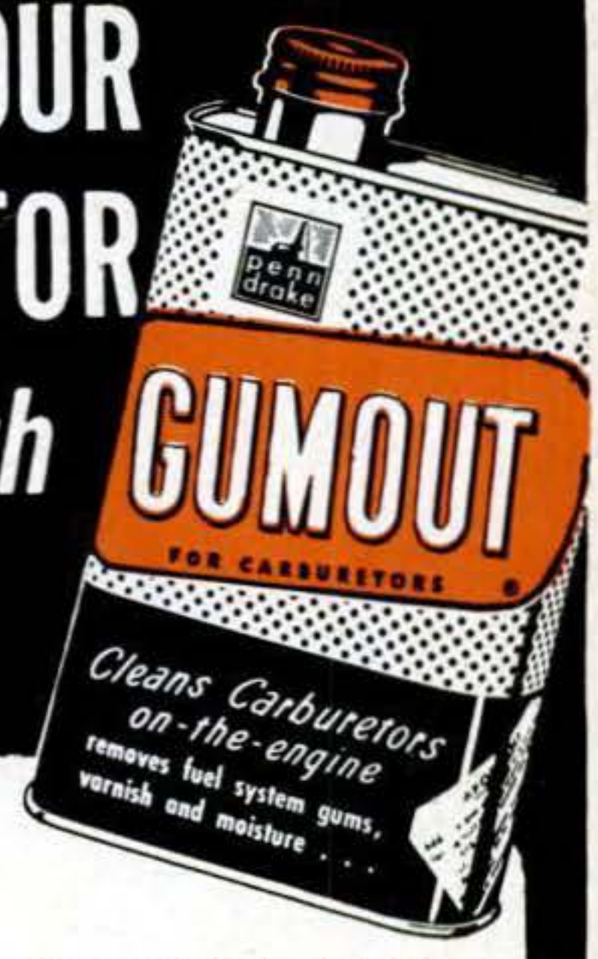

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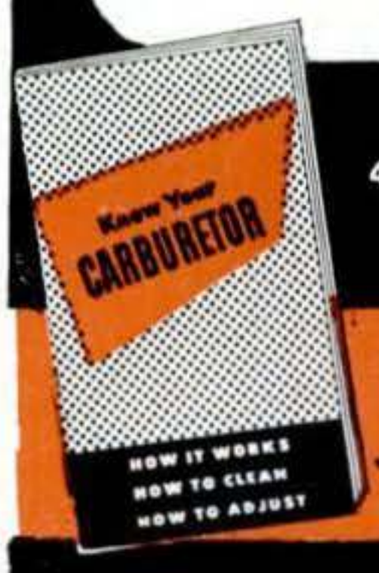

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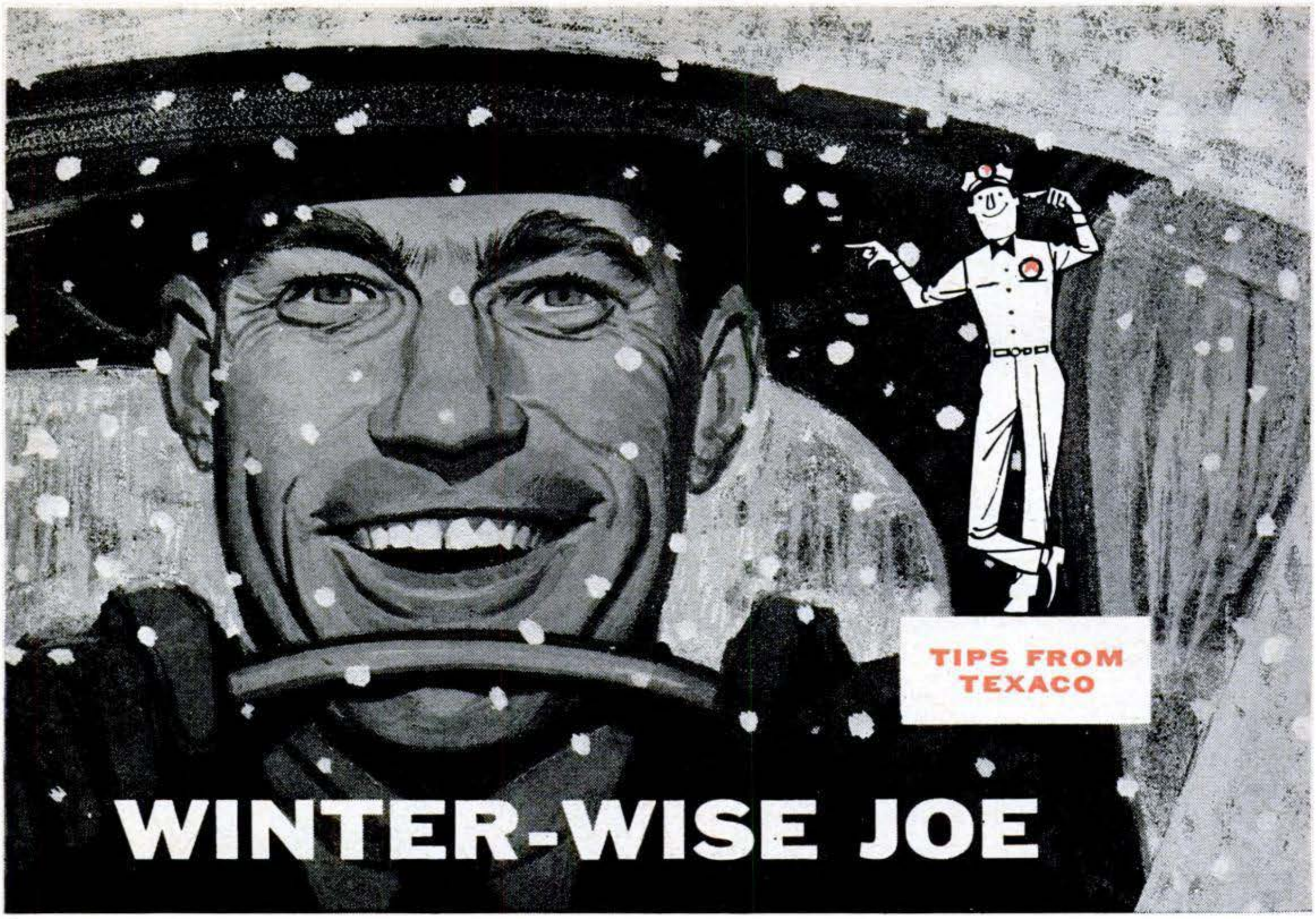

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POPULAR SCIENCE
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The 1958 Ford

How it stacks up against Chevy and Plymouth

By Devon Francis

ONCE upon a balmy summer's day, the heads of Detroit's automobile manufacturing companies met in solemn conclave and adopted a resolution. Their pledge: to encourage motorists "to evaluate passenger cars in terms of useful power and ability to afford safe, reliable and comfortable transportation rather than in terms of capacity for speed."

That was June, 1957.

With the Ford Division's announcement last month of its 1958 products, the "low-priced" cars made by the Big Three—Chrysler Corp., Ford and General Motors—were on the road for comparison. All three lines included "bombs."

In Detroit parlance, a "bomb" is a car that becomes a blur when

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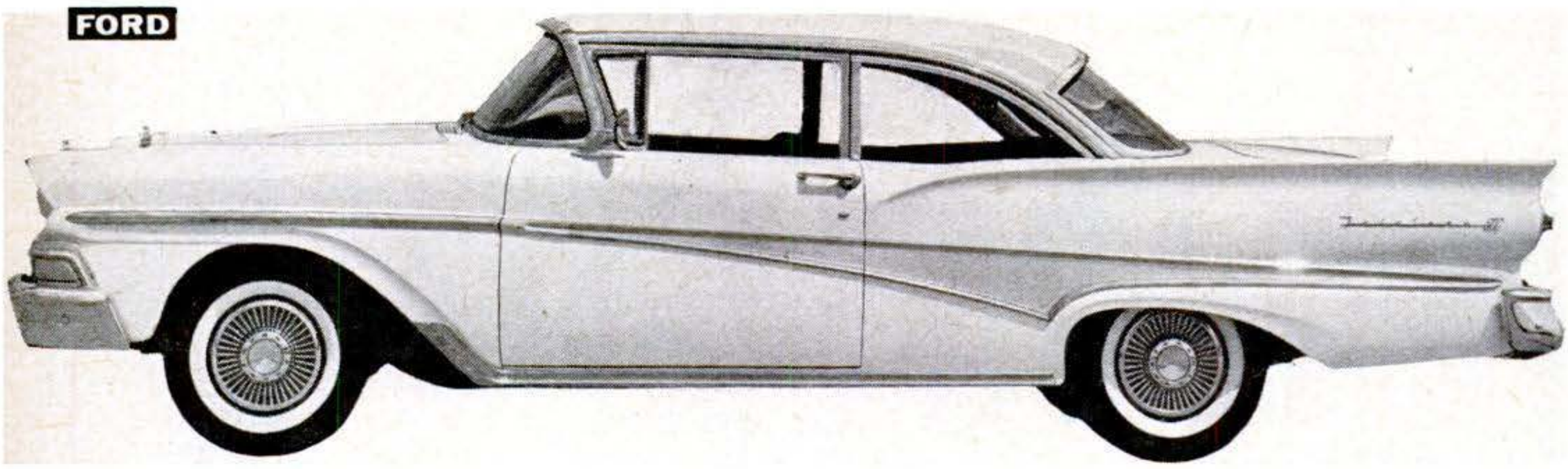
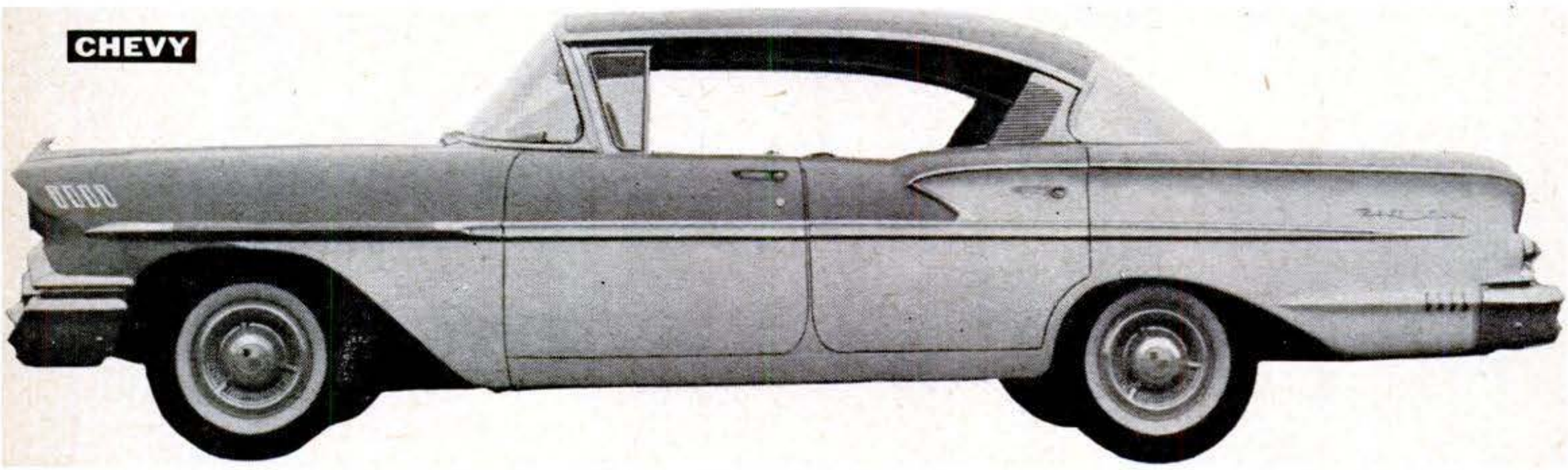
In portrait and silhouette, the three cars most popular





INDIVIDUAL STYLING TOUCHES in the Chevrolet, Ford and Plymouth are easy to spot despite similarities in height, width and length. Ford and Plymouth retain their tail fins. Chevy has

the light turns green. Big Three bombs:

- Chevrolet's bomb is a 280-horsepower automobile, with 348 cubic inches of piston displacement under the hood, that can accelerate from a standing start to 60 miles an hour in 10.5 seconds.
- Ford's bomb is a 300-horsepower automobile, at 352 inches, that can accelerate to the same speed in 9.7 seconds.
- Plymouth's bomb is a 315-horsepower automobile, at 350 inches, with an acceleration time of 9.3 seconds.

For comparison, this is how those same cars, equipped with automatic transmissions, rated in power and acceleration a mere five years ago:

Chevrolet—115 horsepower, zero to 60 in 19.6 seconds.

Ford—110 horsepower, 23.3 seconds.

Plymouth—100 horsepower, 20.6 seconds. For 1957, the top horsepowers for these cars—excluding that for Chevrolet's competition Corvette—were: Chevy 245, Ford 245, Plymouth 235.

The horsepower race for the Big Three, in other words, still shows no signs of breasting the finish tape.

While these prodigious, optional engine

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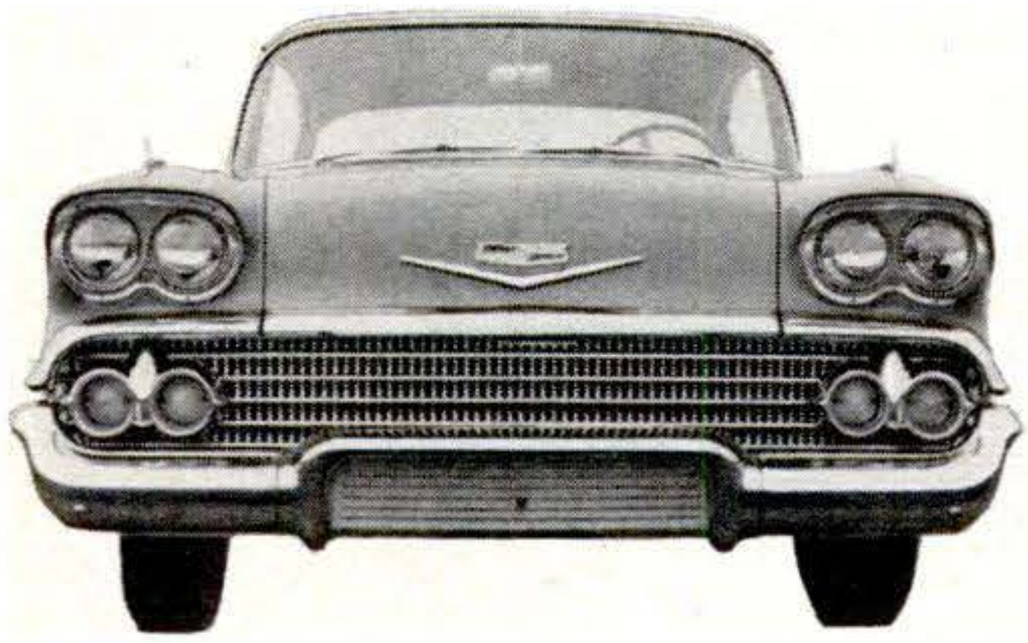
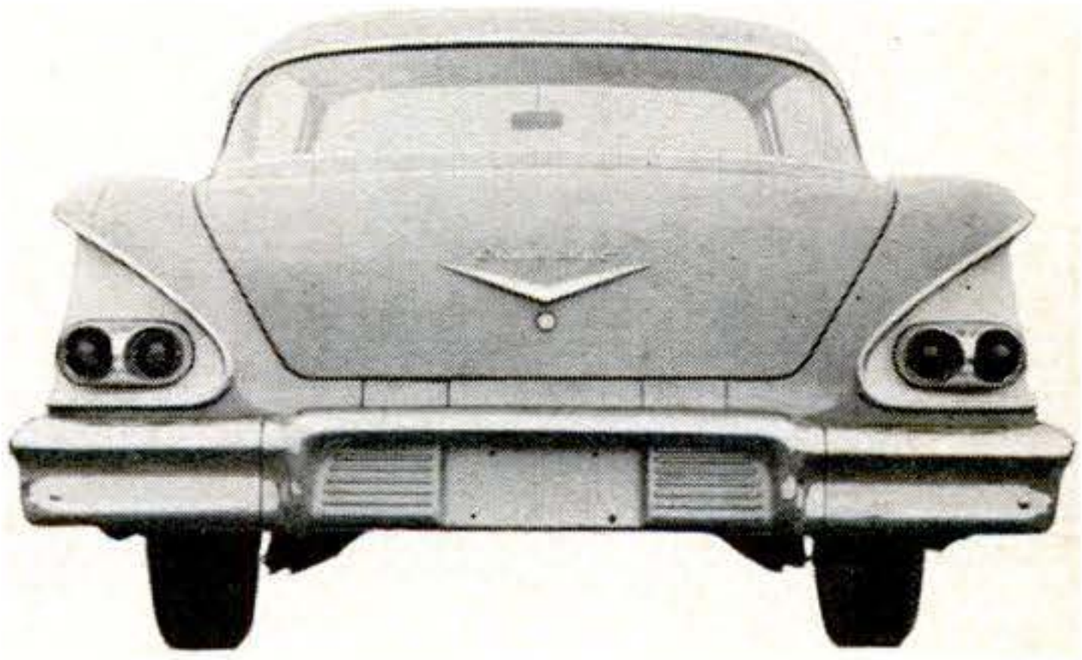
with the U. S. motorist share that low, wide, long look





none. While a casual glance might confuse the three front ends, the side and rear views afford foolproof identification. Both Ford and Chevrolet feature twin-lens tail lights.

sizes may excite the most interest in the new model year for the three biggest-selling domestic cars, they are by no means the most important changes.

Chevrolet has made vast improvements in its fuel-injection system. Ford has redesigned its automatic transmission. Plymouth has extended its optional three-speed automatic box beyond its Belvedere series to include all its lines.

Chevrolet has a brand-new frame with no side rails. Ford is back from the beauty parlor with a "flatter" look. Plymouth has a better power-steering unit.

Two of the three cars offer air suspension.

All three come standard-equipped with four headlights.

All three have the fashionable stoop-and-squat entry.

All three ride with the downy softness of sofa pillows.

All three are insidiously pretty.

All three—once again!—cost more than comparable '57 models.

Let's move in for a close-up of the Ford-Chevy-Plymouth products for 1958—one car at a time—starting with the

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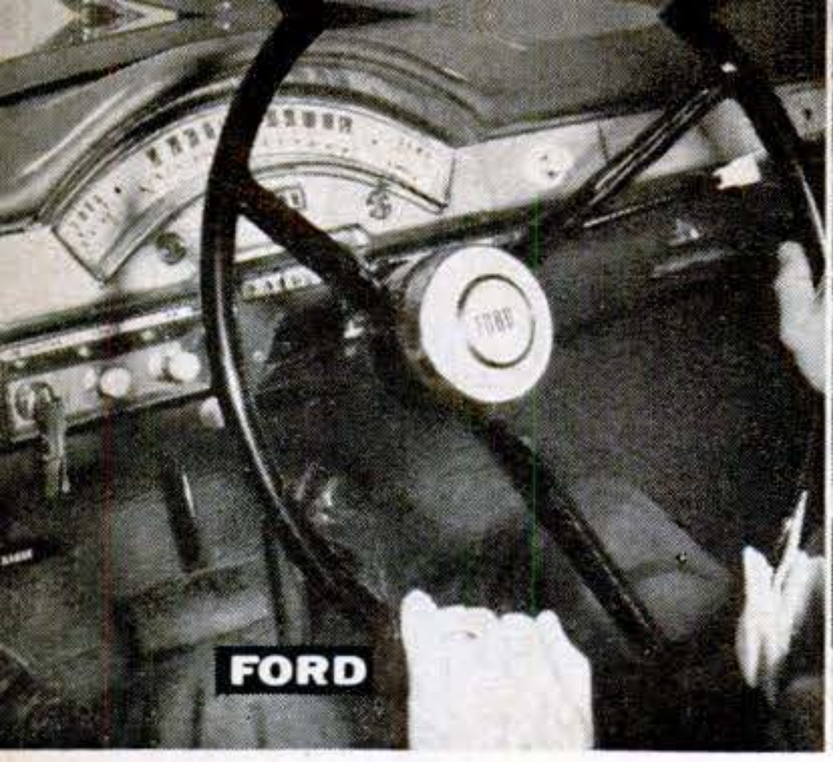
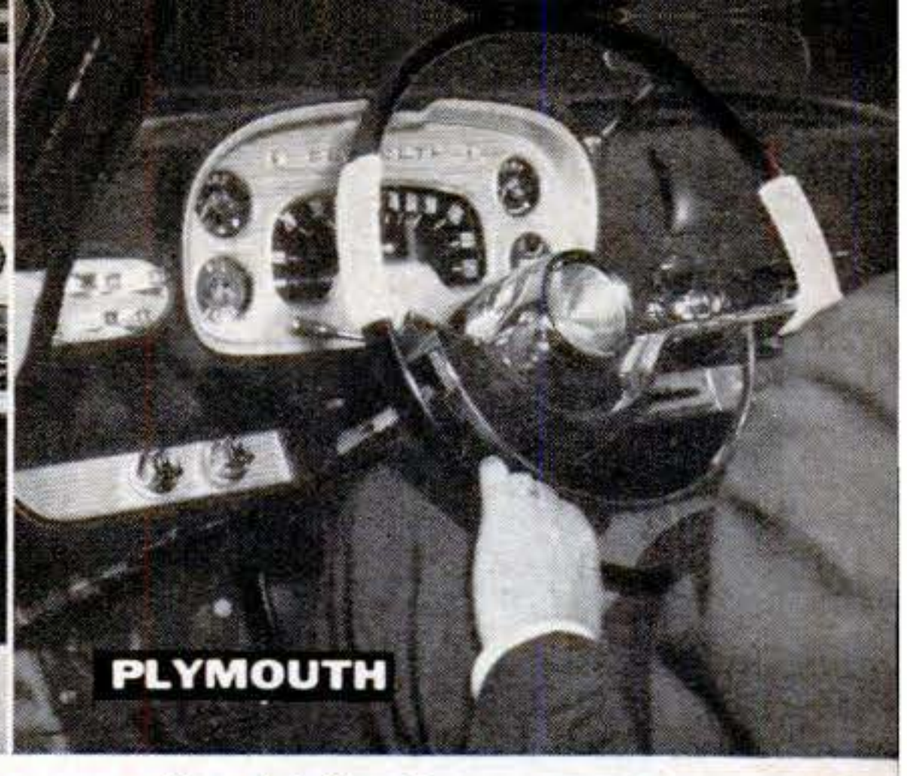
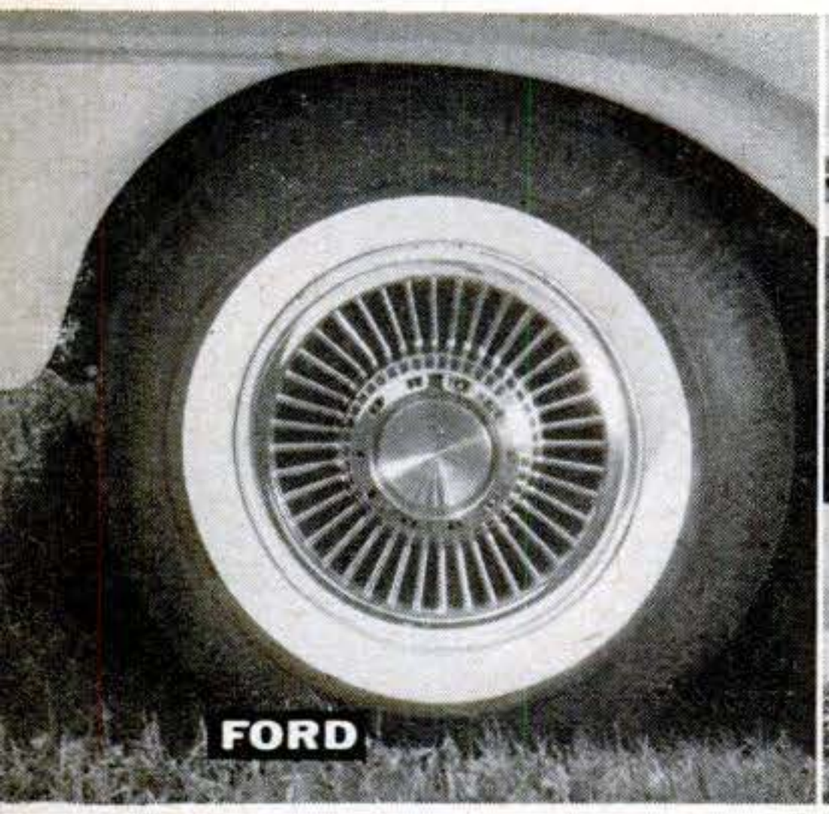
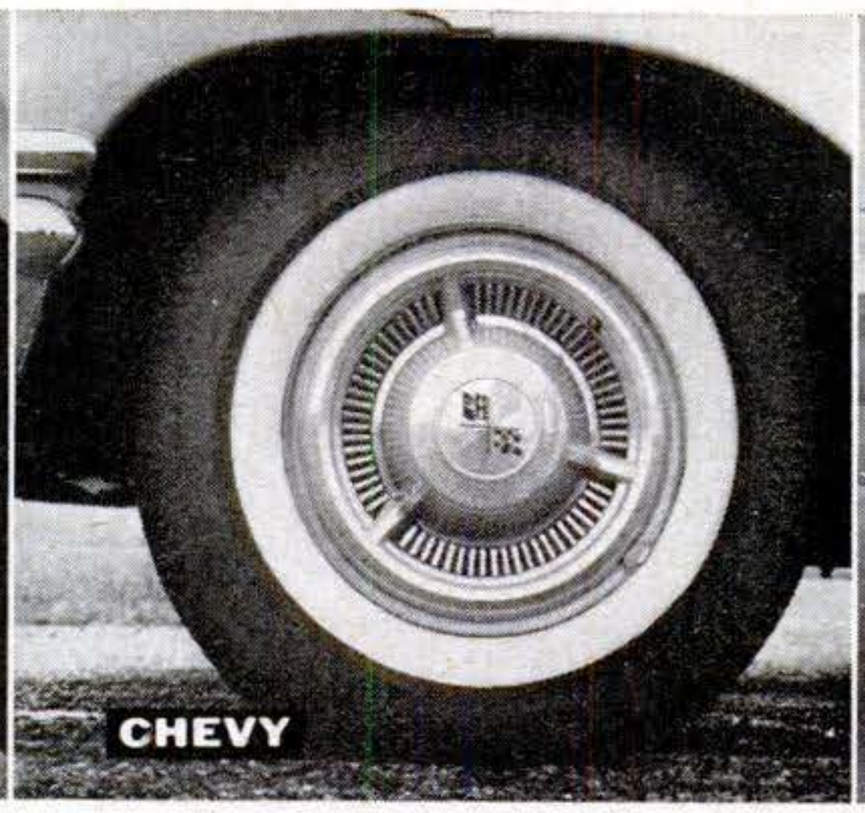
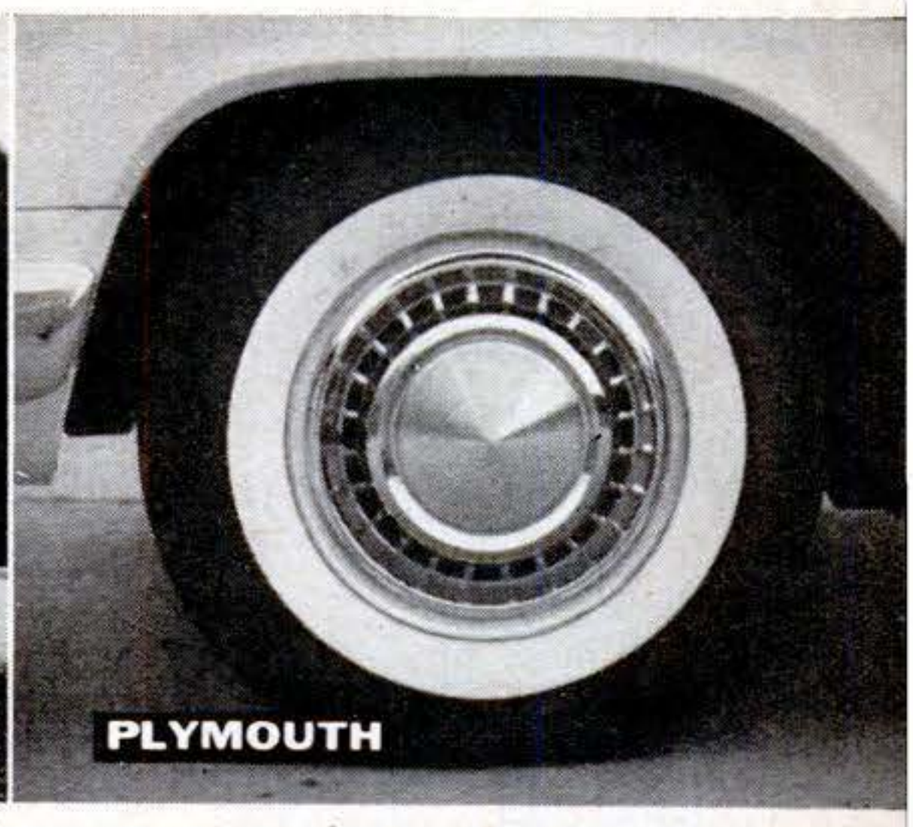




INSTRUMENTS AND CONTROLS in all three cars tend toward close grouping directly in front of the driver. More responsive, higher-torque automatic transmissions are common options.







DISTINCTIVE WHEEL PLATES are features on all the cars. Some Ford models are up slightly in turning-circle diameter—41.6 feet. Chevy's is 41.3 feet. Plymouth's remains at 42.4.

last of the three to undrape in the nation's showrooms.

FORD

This year there are four engine displacements but *five* options, compared with seven for 1957. Hold your hat now, because this gets complicated.

A 223-inch, six-cylinder, 145-hp. engine can be had in most models. A 292-inch, 205-hp. V-8 is limited to the Custom and Custom 300 lines. A new 332-inch, 240-hp. engine is only for the Fairlane line and station wagons. The same engine with a four-barrel instead of a two-barrel pot, at 265 hp., is only for the Fairlane 500. That new 352-incher with 300 hp., previously mentioned, can be had in all lines *except* the Custom and Custom 300. Finally, to satisfy shoppers who aren't completely confused at this point, the 332-incher, with four barrels and *two* exhausts, *is* available in the Custom and Custom 300.

How They Compare

The following figures apply to a four-door sedan, in each company's top line of cars, carrying a volume-production engine and an automatic transmission. All measurements are in inches except where otherwise specified.

	HORSEPOWER	PISTON DISPLACEMENT (cubic inches)	BORE AND STROKE	COMPRESSION RATIO (:1)	HORSEPOWER PER CUBIC INCH	CAR WEIGHT PER HORSEPOWER (lb.)	MAXIMUM TORQUE (lb./ft.)	OVERALL MAXIMUM TORQUE MULTIPLICATION OF TRANSMISSION (:1)	FUEL REQUIREMENT	STEERING RATIO (:1)	
										Manual	Power
CHEVROLET	230[a]	283	3.875 x 3	9.5	.81	15.6	300	3.82	Prem.	23	23
FORD	265[b]	332	4 x 3.3	9.5	.8	14.1	360	4.56	Reg.	27.1	27.1
PLYMOUTH	250[c]	318	3.91 x 3.31	9	.79	15	340	3.82	Reg.	26.8	19.8

[a] Other horsepowers available in six- and eight-cyl. engines: 145, 185, 245, 250, 280. [b] Other horsepowers available in six- and

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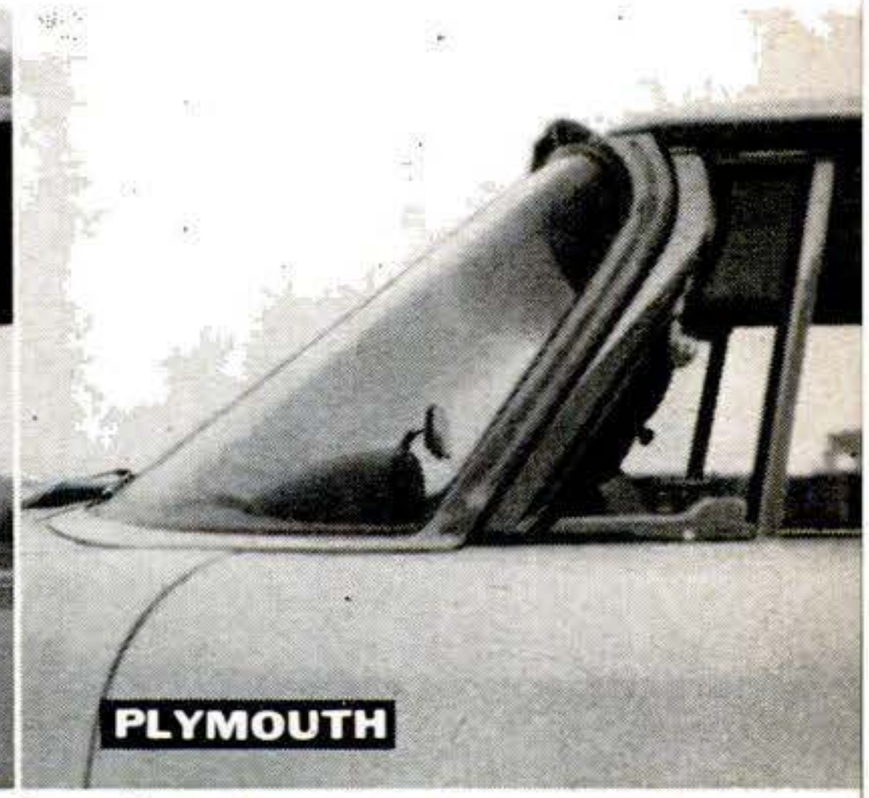
FOUR HEADLIGHTS eliminate necessity of using the same reflector and lens for driving and passing—a necessary compromise in old system. New lamps cut down on glare in passing.



PLYMOUTH'S WINDSHIELD remains the biggest, with 1,444 square inches of glass area. Chevrolet's, at 1,135 inches, has dropped a bit. Ford windshield, at 1,055, is the same as in '57.

Memo: no fuel injection. But spark plugs are out where you can reach them, like Chevy's (PS, Nov.).

Ford had to make one change in a perfectly good automatic transmission because some buyers in 1957 didn't know what they had under their accelerator feet. On the three-speed box, a motorist had to push the pedal clear down through a resisting "detent" to get low gear for a jack-rabbit start.

When complaining letters came from acceleration-happy customers, Ford gathered they had bought something they didn't know how to use. So for 1958, there are two Drive positions on the selector quadrant, in addition to Low.

In D (Drive) 1, the car starts in Low and upshifts through second to third. In D2, it starts in second and upshifts only once.

In D2 the motorist gets a no-cost premium—as he stops, a one-way clutch in the gearing locks everything up tighter

	TURNING-CIRCLE DIAMETER, CURB TO CURB (feet)	BRAKE-LINING AREA (square inches)	GROUND CLEARANCE	WHEELBASE	OVERALL LENGTH	WIDTH	HEIGHT	OVERHANG		HEAD ROOM		SHOULDER ROOM		HIP ROOM		LEG ROOM	
								Front	Rear	Front	Rear	Front	Rear	Front	Rear	Front	Rear
	41.3	157	6.8	117.5	209.1	77.7	57.1	35.8	55.8	35.1	34.6	56.5	56.2	62.1	63.2	44.7	**42.8**
	41.6	181.8	6	118	207.2	78	56.2	35.2	54	33.9	33.6	57.3	57	60	60.1	43.2	**40.8**
	42.2	184	5.5	118	204.6	78.2	56.6	32.2	54.4	35.7	34.2	60.5	60.4	63	62.7	45.5	**41.5**

eight-cyl. engines: **145**, 205, 240, **300**. [c] Other horsepowers available in six- and eight-cyl. engines: 132, **225**, **290**, **305**, 315.

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than a drum. Car can't roll back on hills.

In common with eight other brands of cars for '58, Ford comes with air suspension as an option. These are rubber bags in the place of steel springs, wrapped with a metal girdle and supplied with pressure by a pump.

For an off-year model (the Ford was completely new for '57), the car has been through an exceptional amount of sheet-metal changing. A mock air intake decorates the hood. There's a new aluminum grille. Both roof and front fenders are "fluted." The deck lid has a channel like the Edsel's, but it's narrower.

The hood is 2¼ inches longer, the deck a half-inch, the entire car an inch wider. There are still two wheelbases—116 and 118 inches—and two lengths. At 207.2 inches overall, the Fairlanes and Victorias actually are a half-inch shorter. But the rest of the brood, including the wagons, ranging from 202.2 to 202.9 inches, are a half-inch longer. Heights? Substantially

Ford improves gasoline mileage

BACK in the days when women wore hobble skirts and men fire-red galluses, a British engineer named Mr. Archibald Sharpe worked out a formula for a long-before-its-time kind of V-8 engine. He also created, for carburetor engines, a problem in fluid dynamics—known indelicately as slobber—that has plagued automobile makers ever since they adopted his formula.

For 1958, Ford has done something about it.

Archie wrote the mathematical description of a new kind of crankshaft—one with the cranks, or "throws," at 90 degrees to each other instead of exactly opposite, as was then the custom in all four- or eight-cylinder engines regardless of type. The formula was designed to keep engines from getting all shook up from vibration.

That was all—no more, no less. The idea lay doggo for 20 years. Then it began creating quite a stir in the internal-combustion business. Among the automobiles that adopted it was the 1929 LaSalle. Henry Ford introduced it on the first low-priced V-8 in 1932.

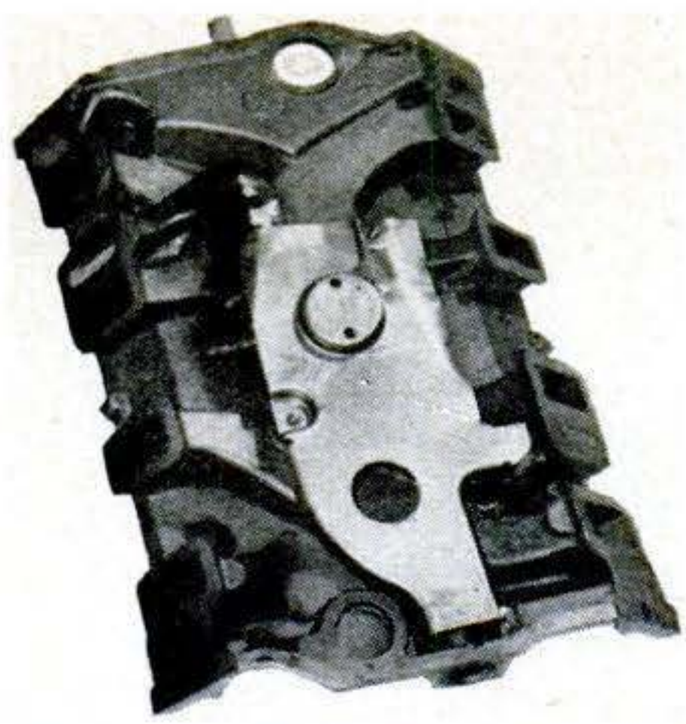
Today it's used universally.

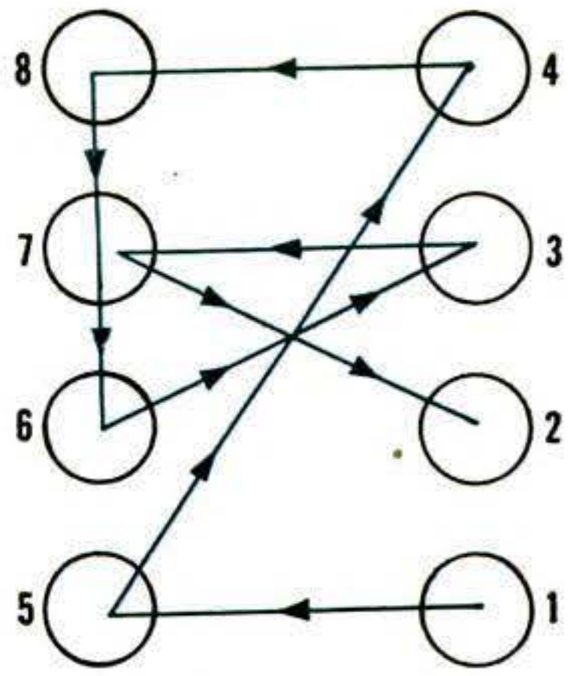
The volume of complications that Archie's idea created was horrendous. But all that concerns us here is that while it did produce a smoother engine, it played hob with the intake manifolding of V-8's.

The old-fashioned V-8's with "flat" crankshafts were two simple four-cylinder engines glued together. Archie's V-8 was also two engines, but with a difference: The four cylinders of each engine were *divided* between the two banks.

The manifolding for the flat-crankshaft engine had been as simple as a child's prayer. That for Archie's was not. The fuel-air flow had to be routed back and forth between the two cylinder banks in a complex maze of pipes. That took some doing.

In the last 30 years, as compressions have gone up and engine design has be-





Old manifold (left) is skimpier than the new. Cylinder firing order shows air-flow problem.

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unchanged from last season's road-hugging offerings.

CHEVROLET

Chevy, *all* new in Detroit's annual game of musical chairs, has five engine options. First there is the company's Old Reliable, the 235-inch, 145-hp. six. Then comes the first of the V-8's, a 283-incher, second-lowest on the totem pole because a 265-inch engine has been dropped. It ranges in power from a two-barrel-carburetor job at 185 horses, through a four-barrel at 230 and up to a fuel-injector at 250. On top is the 348-inch bomb.

Most of these options are available on most any Chevrolet.

A lot of work was done on the big engine's carburetion. During proving-ground driving the engineers recommended options of three two-barrel pots or one four-barrel. The conventional four-barrel carburetor turns out 250 horsepower.

[Continued on page 220]

with bigger intake manifolding

come ever more sophisticated, the intake manifolding has assumed the appearance of a snake nest in spring.

An internal-combustion engine is essentially an air engine. It pumps air. In less than 50 miles, a 332-cubic-inch Ford engine driving a 2.69:1 axle will pump enough air to fill an eight-room house. The fuel, of course, goes along in suspension.

All the twists and turns in the intake manifolding of today's V-8's cause part of the gasoline to play hookey from suspension and condense, more in the piping to some cylinders than to others. Raw, indigestible fuel slobbers into the cylinders—into some more than others.

Slobbering engines are fuel hogs. The fuel-air mixture has to be enriched to the appetite of the cylinders receiving the lightest burnable charge. The other cylinders get *too much* gas.

That's where Ford for '58 comes in.

The Ford Division has simplified its intake manifolding. Increasing the size of the manifold area gave more space to route the piping. That enabled the engineers to remove some of the kinks that produced the condensation.

Space for the intake manifolding in V-8's has been at a premium ever since Archie's inspiration of 1909 became common law. There's so little room between the banks. The Oldsmobile Viking of the late 1920's used valves turned almost horizontally to make way for better manifolding. Reciprocating-engine designers were searching for *lebensraum* long before Hitler.

Where did Ford scrounge the added space? From the cylinder-head area, which has been shrinking anyway as compressions have risen.

When POPULAR SCIENCE asked a Ford engineer why no one had done this before, he asked in turn, "Why do you still wear a necktie?"

Ford's new V-8 engines for the new model year have those bigger intake manifolds.

Ford's six, at 145 horsepower, remains much in evidence. And, by the way, six-cylinder engines don't have that rocking-couple problem. Never did have. That's because the pairs of cranks are at 180 degrees to each other, and there are always two cranks in the middle which just naturally cancel out vibration. As a breed, the six is as mannerly as Little Lord Fauntleroy. Many V-8 engineers are said to dream wistfully of it after a hard day.

Well, the bigger Ford intake manifolds have paid off. The 332-cubic-inch engine for 1958 gets 10 percent better gas mileage than the 272-cubic-inch for 1957. The new 352 engine is 15 percent better on gas than 1957's 312.

Not all of this, to be truthful, is due to easier in-breathing. Part comes from some cam-shaft de-tuning, so a motorist can get more horsepower at a lower r.p.m. In some instances, it comes from a lower axle ratio. In the new dual-range automatic-transmission Fords, it comes from a change in the three-speed arrangement —so a driver no longer has to put his foot in the carburetor to get a low starting gear. Takes some load off the engine.

But a substantial amount of gas is saved because it isn't slobbered away.

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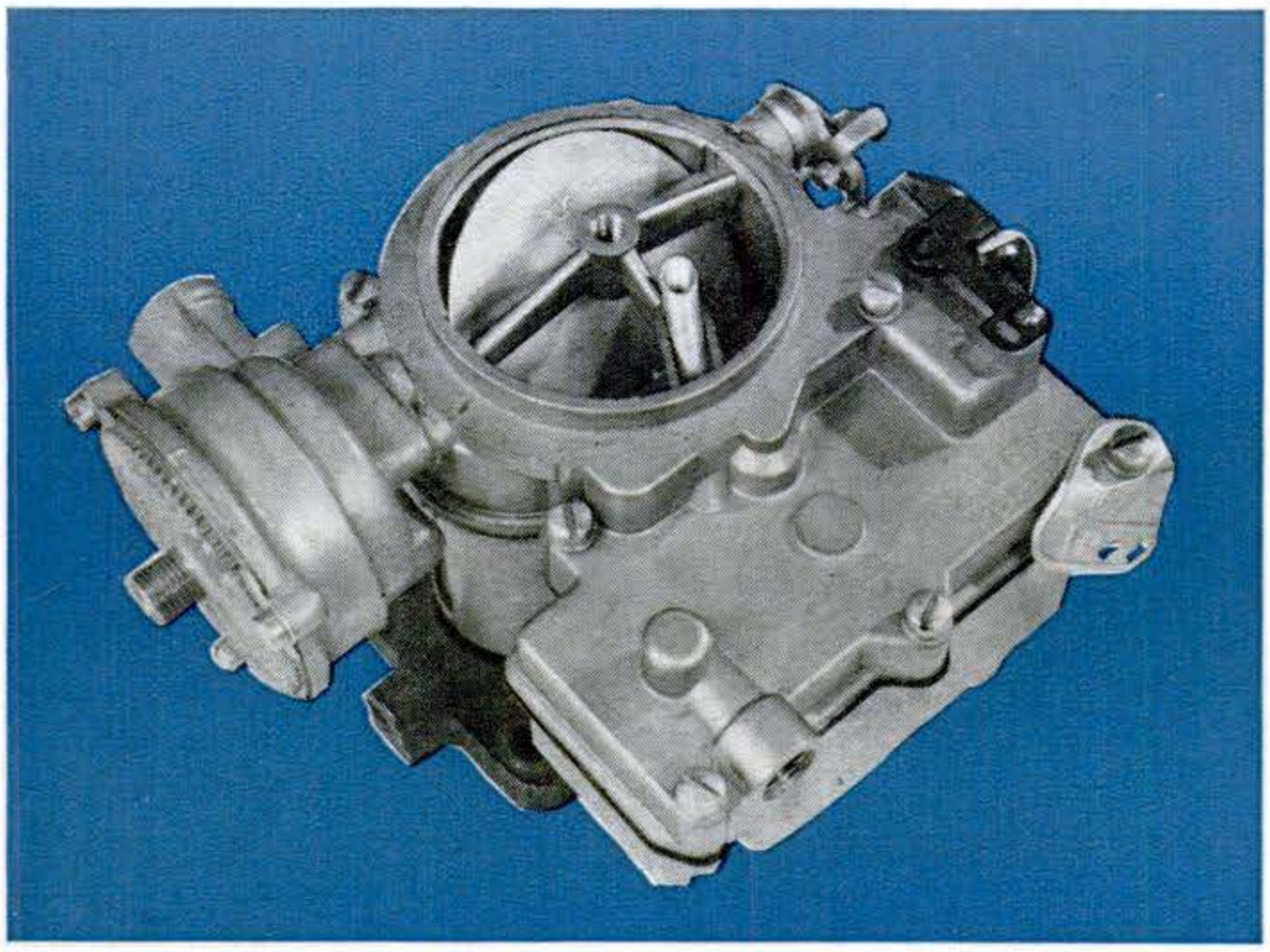
New Olds Lowers MPH to Lift MPG

By subtracting from the high end of performance, engineers get new fuel economy, even on a three-pot engine

TWO INCHES WIDER and an inch lower, but with same overall length as in **'57, new Oldsmobile retains little of its former appearance. Forged aluminum grille carries series identification.**



ECONOMY VERSION of **Olds' carburetor is smaller, has only two barrels. Faster air flow through intake manifolding permits use of leaner mixture. (Four barrels and three two-barrel pots also are available.) Lower axle ratios pinch pennies, too.**

IF YOU are getting, say, 18 miles to the gallon of gas out of a 1957 Oldsmobile 88, there's news for you in the 1958 crop of Lansing-made automobiles. You can get 21 miles to the gallon, and even more, from an 88. You can get almost as much from the more powerful Super 88 or 98.

There's a reason. Oldsmobile—which started the crescendo of horsepowers in the industry just nine years ago with the first of its Rocket engines—has taken a bold step.

It has subtracted from some of the performance at the high-speed end of the horsepower output and added the result

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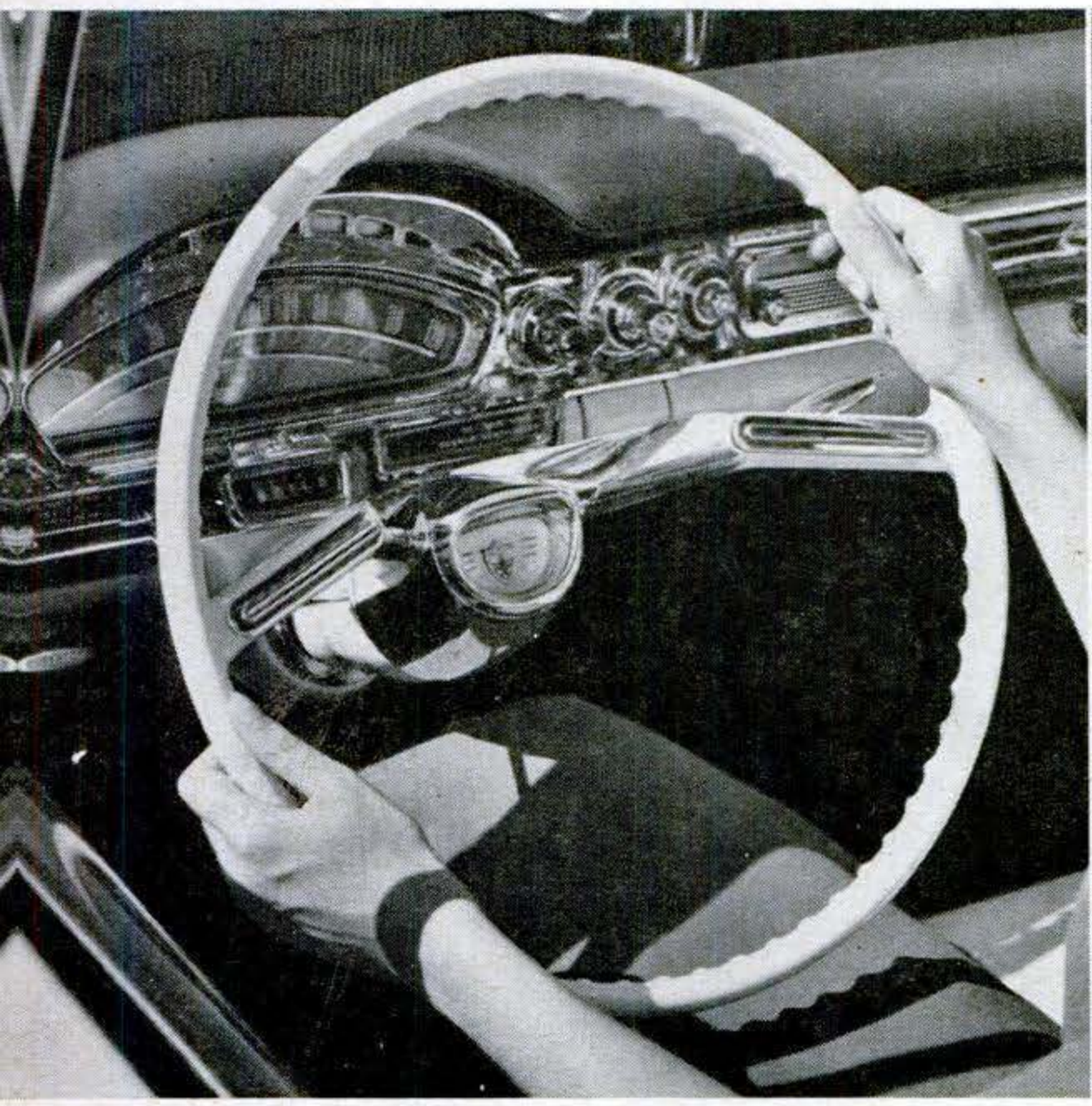

ELONGATED BUTTONS replace horn ring on Oldsmobile's deep-center, two-spoke steering wheel. Revised Hydra-Matic transmission, shared with Pontiac, Cadillac, is livelier in cold weather.

FUEL FILLER PIPE is just ahead of left rear running light and under chromed fender crown. "Exhaust" holes in the bumper are only for looks—pipes are hidden under the body.

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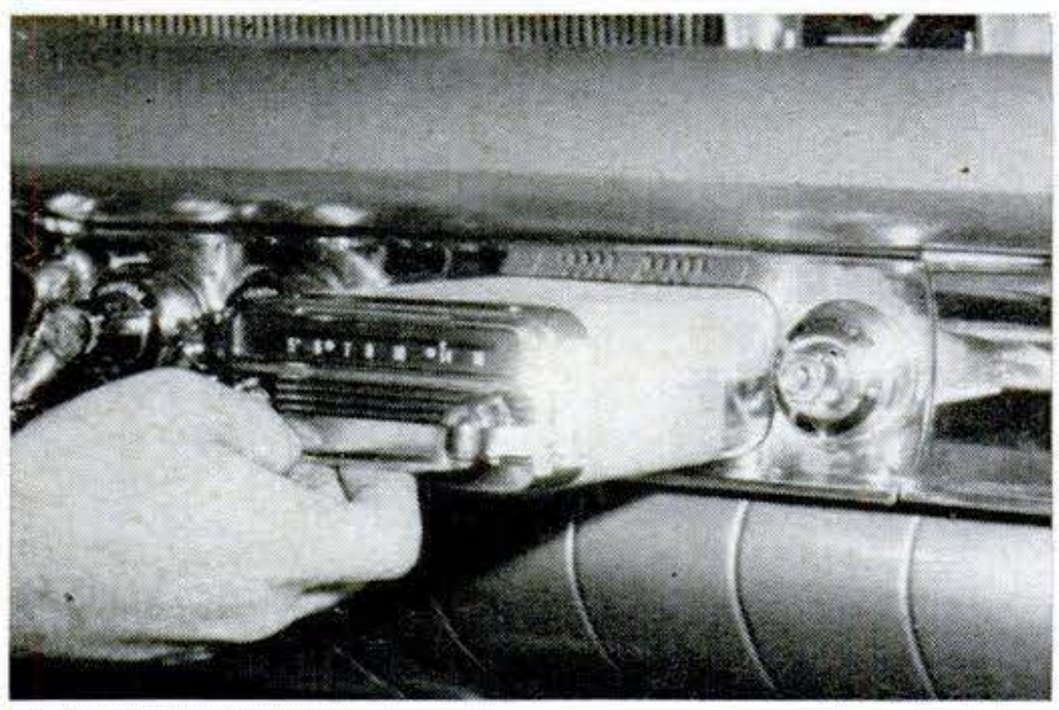

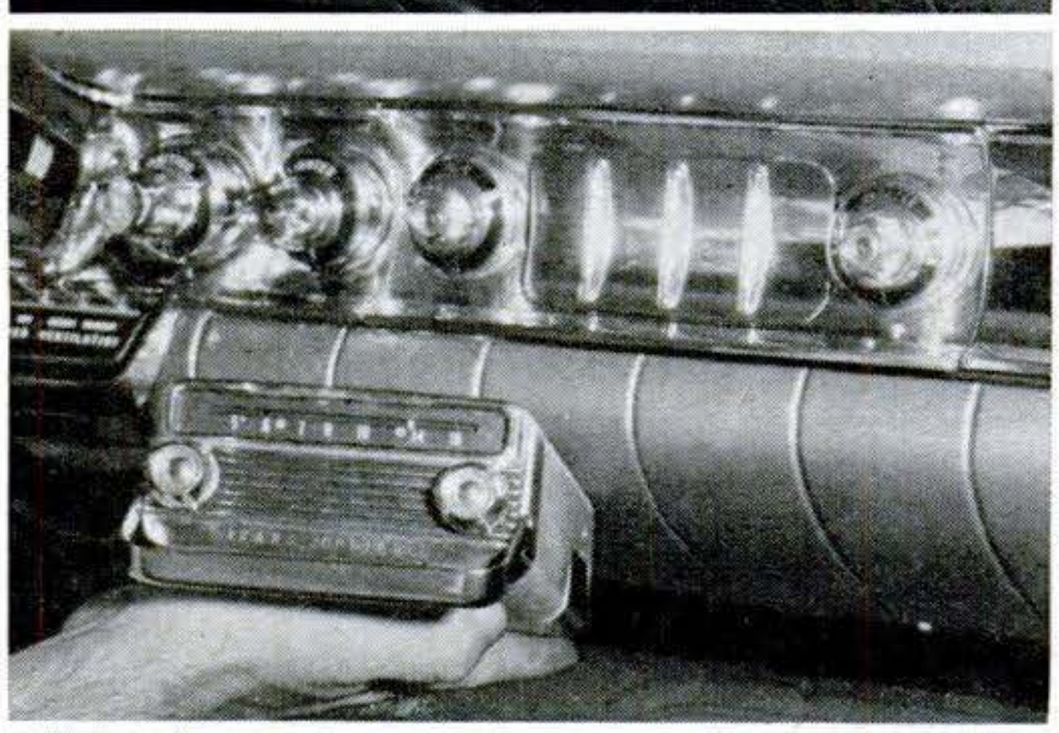

REMOVABLE RADIO, an option, is pulled out of panel by folding handle. In car, it uses car's antenna, speaker system, radio-control knobs. Small padlock, and release button inside glove bin (which can be locked), theft-proof it.

to fuel economy. Here's the reasoning:

"For years," remarked an Olds engineer, "everybody in the business has been pushing up horsepower and putting it in performance at the expense of economy. We feel that it's time for a compromise."

To which many a U. S. motorist will add: Amen.

Olds has done nothing that any other manufacturer can't duplicate. It has refurbished its high-performance, gas-eating camshaft. It has redesigned its intake manifolds. It has reduced its axle ratios.

The 88 series of cars actually is down in horsepower from 277 to 265. But the nub of the change in this car is in the intake manifolding and carburetion. Attacking the economy problem differently from Ford (p. 78), Olds shrank the size of its intake piping. That speeded up the velocity of the air flow through a single, two-barrel carburetor. That resulted in better atomization of the fuel. And *that* permitted a leaner mixture.

Horsepowers of the Super 88 and 98 lines, with four-barrel carburetors, *are* up. As against 277 horses for 1957, these engines now produce 305. Optional on all lines are three two-barrel pots producing 312 horsepower. Used at sensible speeds, they are economical of fuel, too.

Economy is easily half the story in the 1958 Oldsmobile. The other half is appearance. The stylists made a bilious appraisal of the sheet-metal configuration on their '57 vehicle and then threw tradition to the winds.

That Oldsmobile look is gone. The "mouth" in the grille has disappeared. The tuck in the beltline is moved forward. The inevitable chrome is in horizontal lines, accenting length, instead of swooping at the rear treads.

There's an optional air-suspension system that may well prove to be the best in the industry. Filters purify the air before it enters the system, and thereafter the air can be recirculated among air bags. The Olds people say this eliminates the possibility of failures caused by dirt, ice or snow getting in.

As for the sacrifice of performance to economy, it's perceptible only at speeds above 65 miles an hour. By the merest coincidence, that's just about all that the law allows, where speeds are restricted, from the rock-bound coast of Maine to the smoggy shores of California. END

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'58 Pontiac Is Longer Than Ever

FROM ANY ANGLE, head-on, back, or sculptured side, new heavy-muscled Pontiac looks bigger.

A HALF-CENTURY ago a chap named Ed Murphy manufactured buggies in a factory on Oakland Avenue in Pontiac, Mich. They had one horsepower—that is, one horse. In the intervening years, the factory dispensed with whip sockets and shafts, and installed internal-combustion engines. The company founded by Ed Murphy now is producing self-propelled buggies with up to 310 horses.

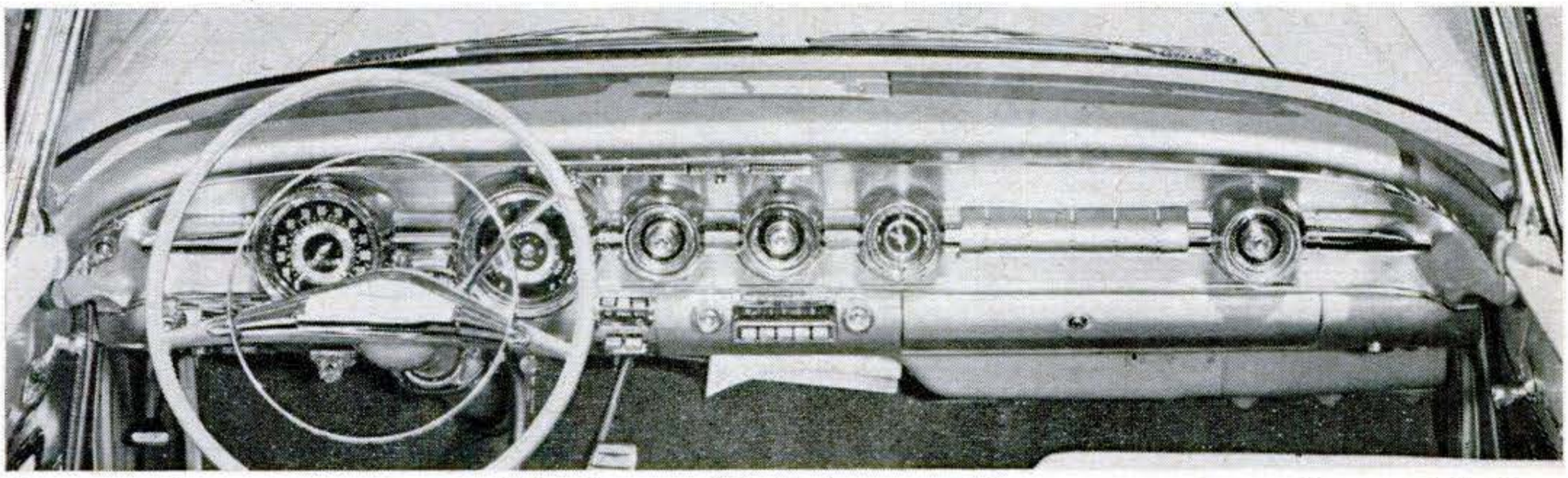
That's Pontiac for 1958.

The car sailed into the nation's showrooms last month with the majesty of a new ocean liner. It was:

- Longer by as much as nine inches.
- Lower by as much as 4½.
- Wider by more than two.
- Snappier by far.

For the 50th anniversary of General Motors—of which the Pontiac Motor Division is a prominent part—the car was new from prow to stern.

It had an X frame like the Cadillac and Chevrolet. For the first time in its history, it had coil springs all around for a softer ride, with air bags optional. Its fuel-injection system had been tested in



Recessed instruments have white figures, black faces, with orange pointers for readability.

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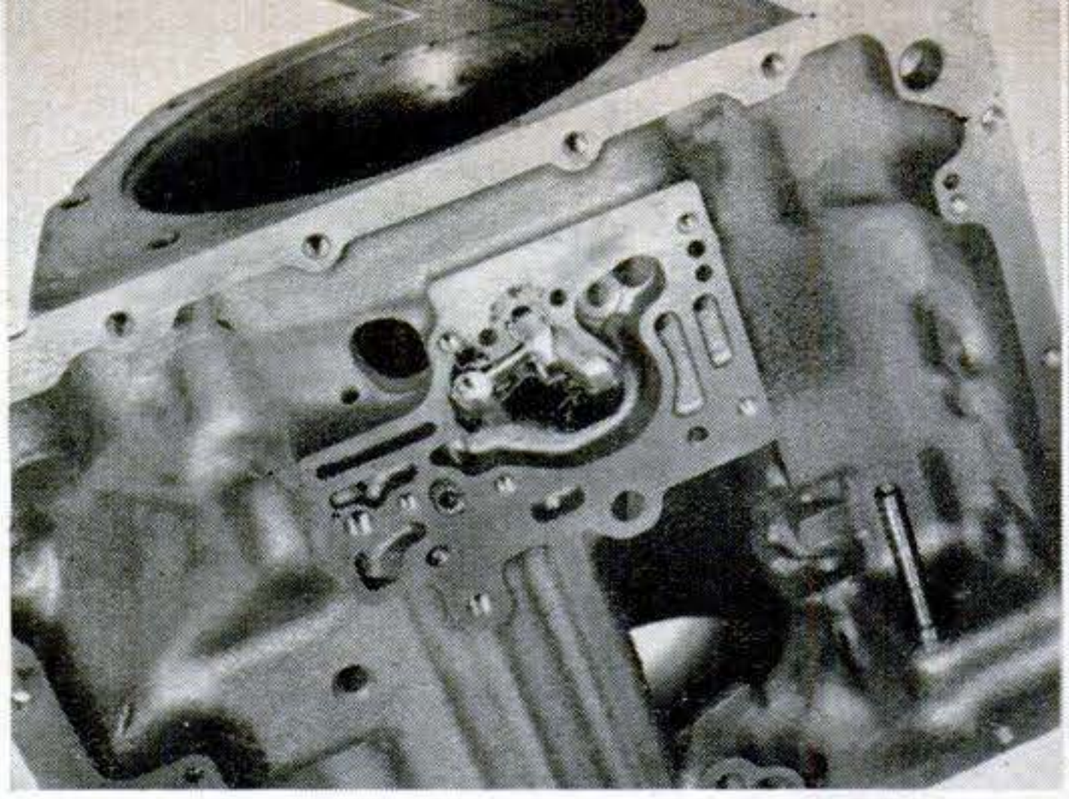
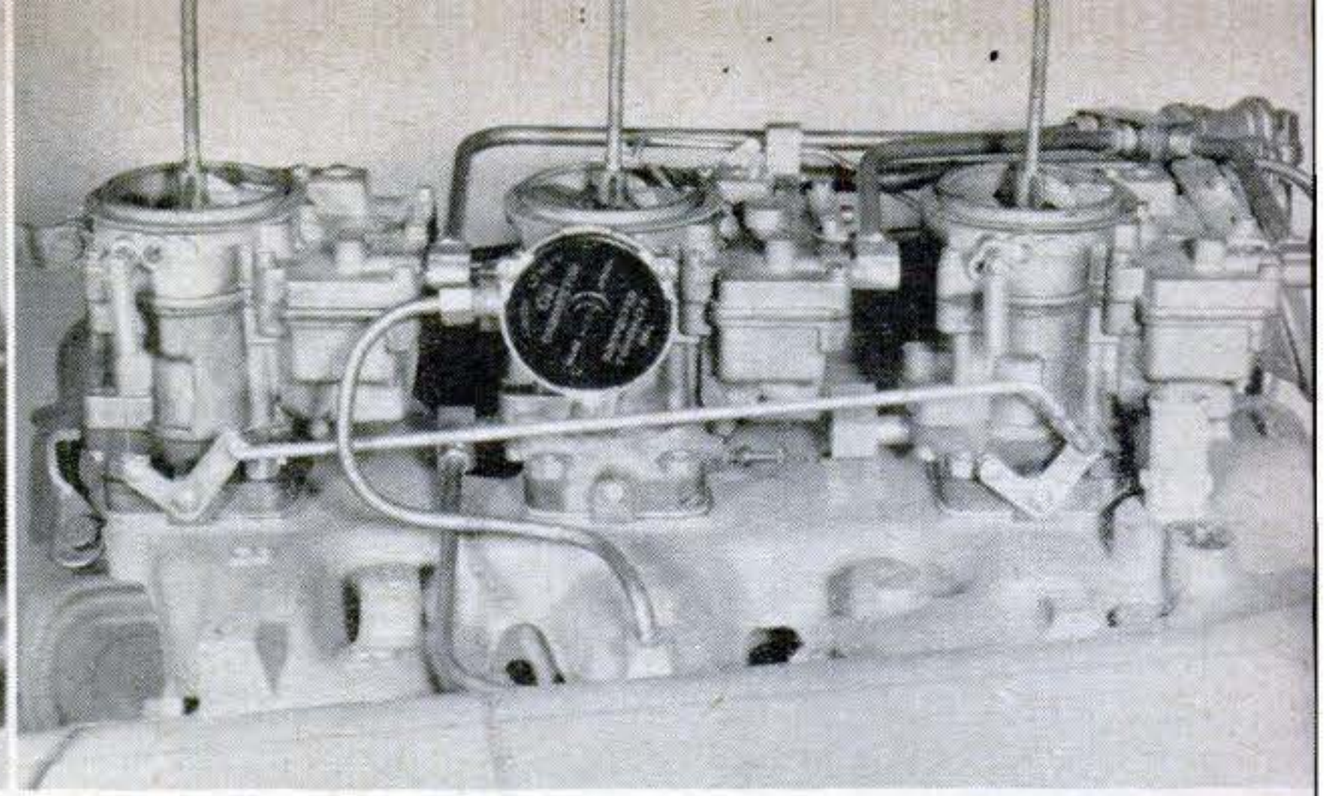
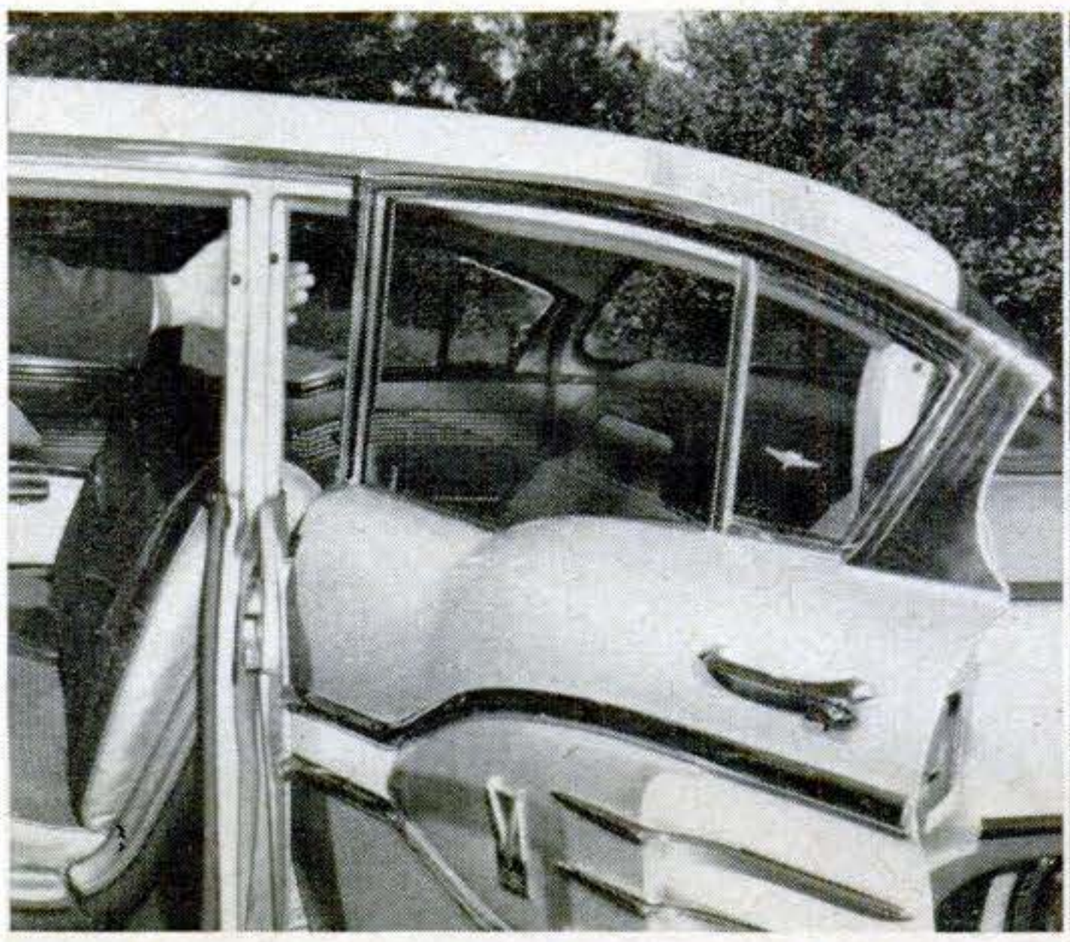


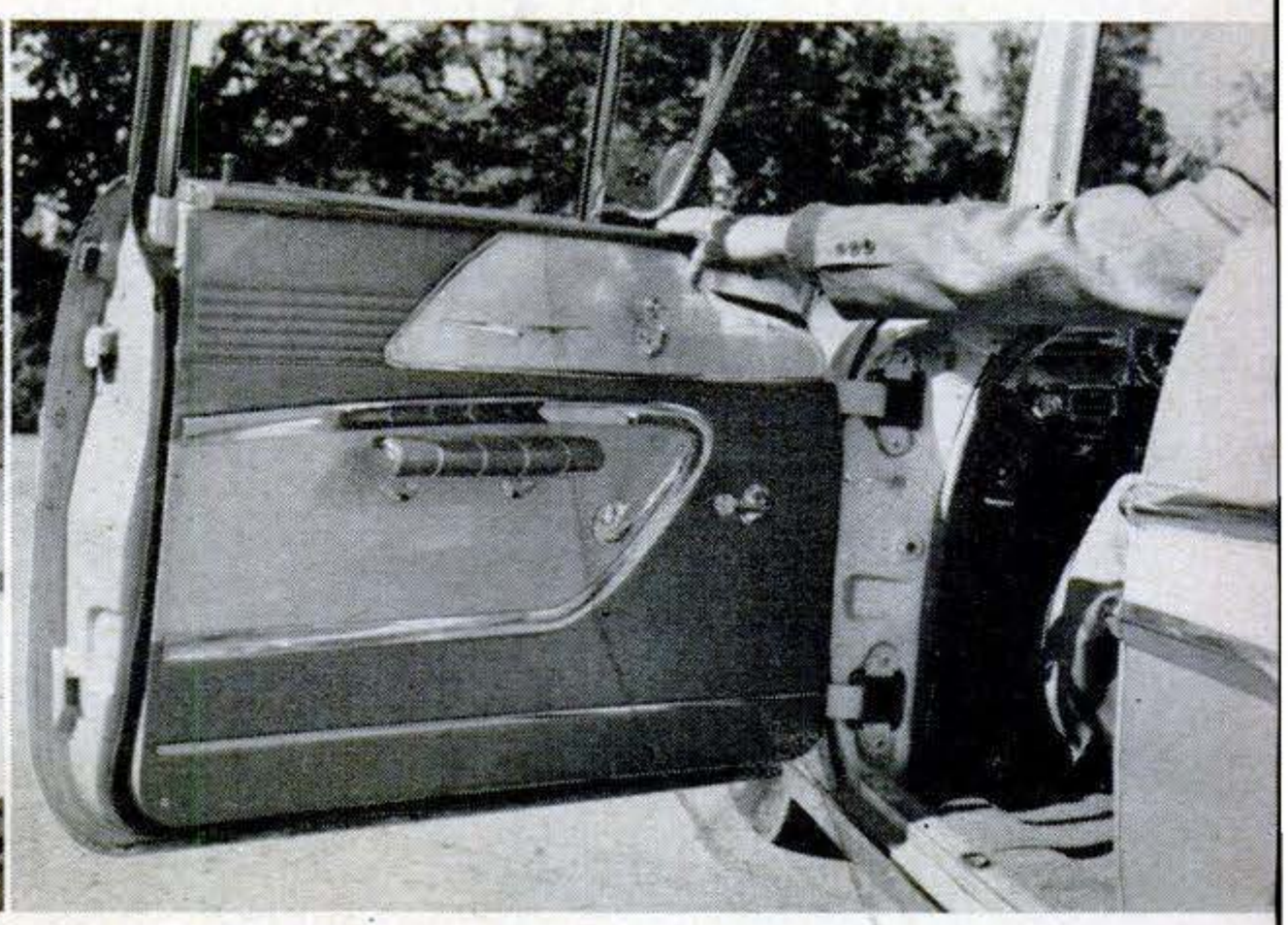
EXPOSED VALVE BODY shows one of two thermostats (in center) added to Hydra-Matic transmission for livelier cold-weather operation. Change is most apparent in 0-20 degree range.



THREE TWO-BARREL CARBURETORS supply 300 hp. on this 370-cubic-inch engine; fuel injection gives 310. Engines with 8.6:1 compression ratio use regular fuel; 10:1 ones need premium.



THIN PILLAR on Star Chief four-door sedan contributes to hardtop look. Lowest model is the Bonneville sport coupe—55.6 inches.



INTERIOR TRIM pushes GM's higher-priced vehicles for elegance. Windshield area is up 84 square inches. The hood is an inch lower.

service and now was ready for any and all customers with the price. There were two new series of Pontiacs—the Bonneville, in flavors of convertible and sport coupe, and the Super Chief, on a longer wheelbase. The sheet metal on all models had that guided-missile sculpturing. Note: no fins.

One of the biggest changes in the Pontiac's behavior—shared for the new year with Oldsmobile and Cadillac—centers on the addition of two little bimetal thermostats in the Hydra-Matic transmission. Two years ago the gearshifts in this automatic box were smoothed out by the substitution of a tiny fluid coupling for one of the clutch-band combinations (PS, Nov. '55).

But when the frost was on the pumpkin, and chilled oil thickened, the gears got sluggish. They "hung on" past a decent interval in accelerating. They thumped. That's mended now. One of the two thermostats opens a valve to quicken the filling and emptying of the tiny fluid coupling until the oil heats up. The other one does the same kind of job in the transmission's valve body, the "brain" that upshifts and downshifts.

Last January, Pontiac engineers took some of the revised transmissions up to that Minnesota town that's always figuring in the winter's b-r-rr news, Bemidji. Worked fine.

In engines, the new Pontiacs are a Kris Kringle's gift sack—there's something for everybody. Starting with a two-barrel-carburetor job at 240 horsepower with a compression ratio of 8.6:1, they run through two barrels at 270 with 10:1, four at 255 with 8.6, four at 285 with 10, three two-barrel carbs at 300 with 10.5 and, finally, fuel injection at 310 with a compression ratio of 10.5:1.

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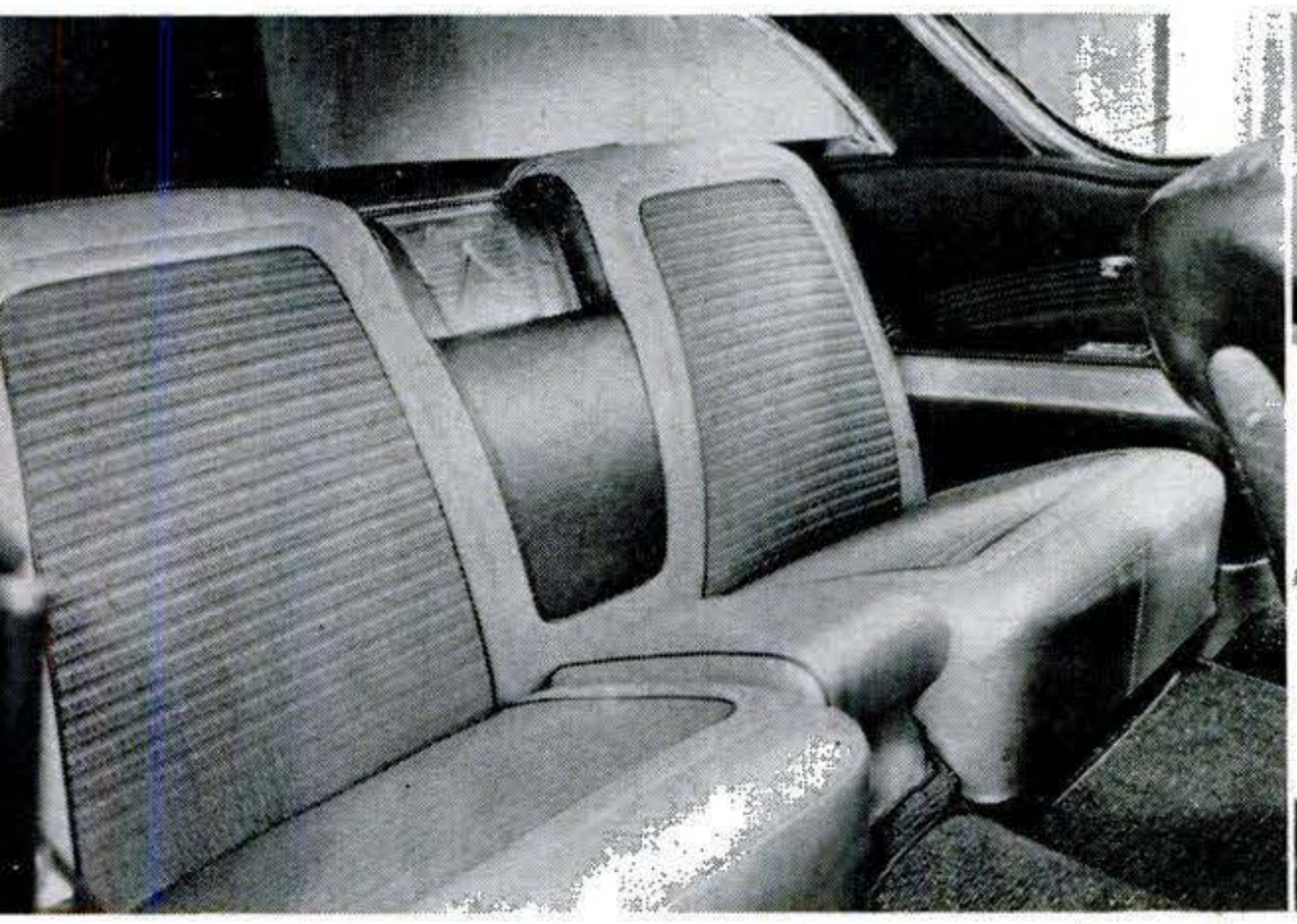
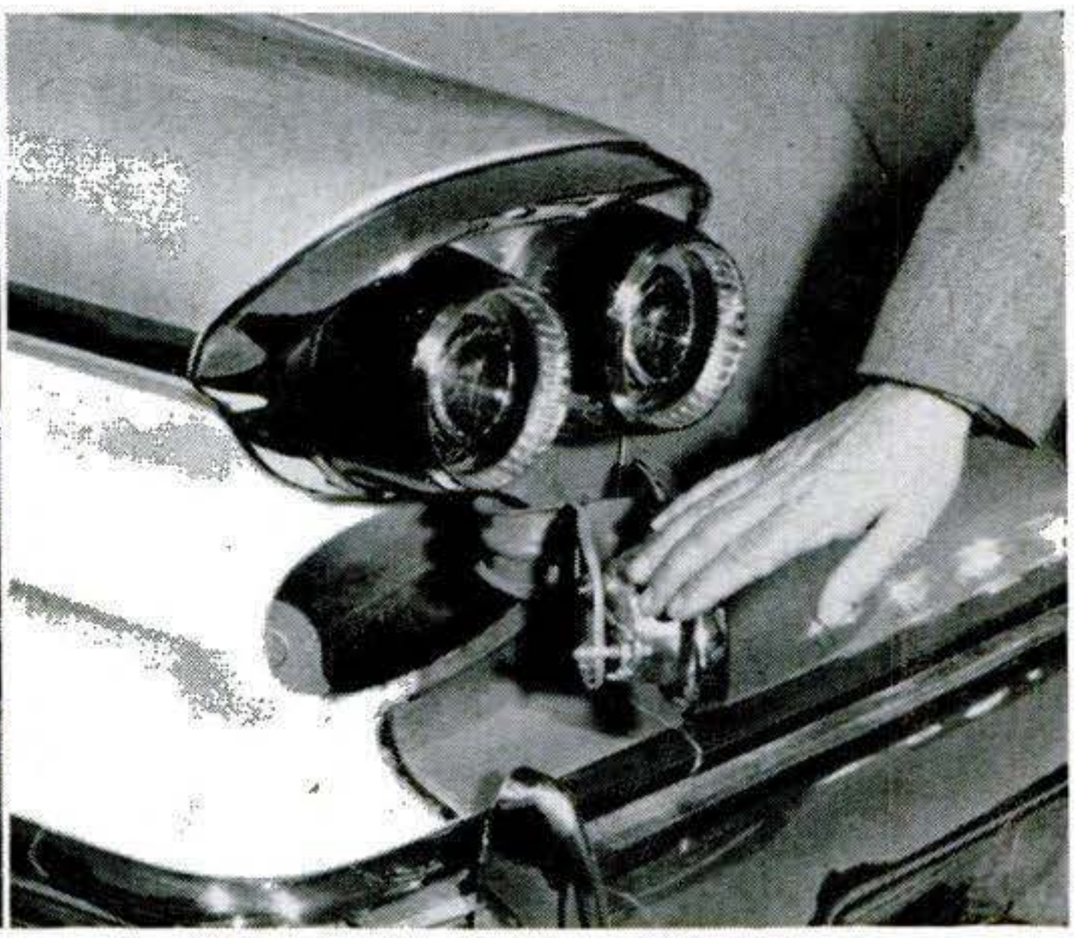
TWO-CYLINDER COMPRESSOR for optional air springs, belt-driven from crankshaft, produces top pressure of 250 pounds per square inch. Override valve can raise the car several inches.

X-TYPE FRAME and propeller shaft with three universal joints contributed to lowering car's silhouette. Ball-joint front suspension has anti-dive control. For the rear: coil springs.



BONNEVILLE SPORT COUPE comes with such fancy items as radio speaker and pop-up armrest in center of rear seat, and chromed seat ends.



FUEL-FILLER DOOR is behind left rear back-up light. Both lamps above are running lights, turn signals. Trunk contains 17 cubic feet.

All these combinations emerge from one basic piston displacement, boosted from 347 cubic inches to 370 merely by boring bigger holes in the block. Exhaust valves and exhaust manifolding are up in size for better breathing. Hand in glove with that are alterations in the valve timing. The intake valves are open four degrees longer, the exhaust valves two. Gases have more time to get in and out.

Gives more miles per gallon.

To performance, the new Pontiacs add glamor. Colors range from Starmist Silver to Reefshell Pink, and on that Bonneville convertible four real bucket seats come as an option. END

General Manager S. E. Knudsen with 1908 Oakland, Pontiac's granddad, and '58 product.

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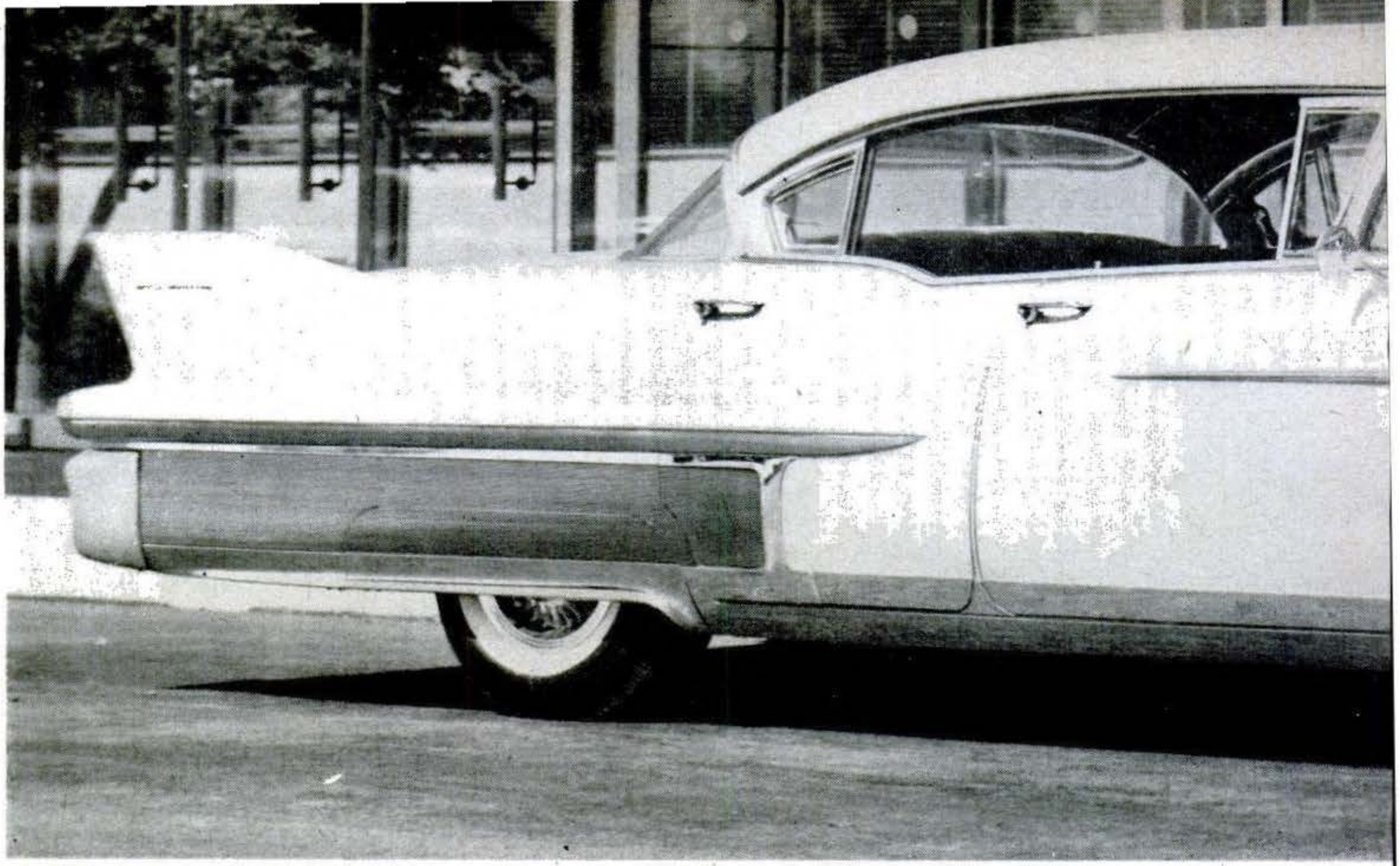
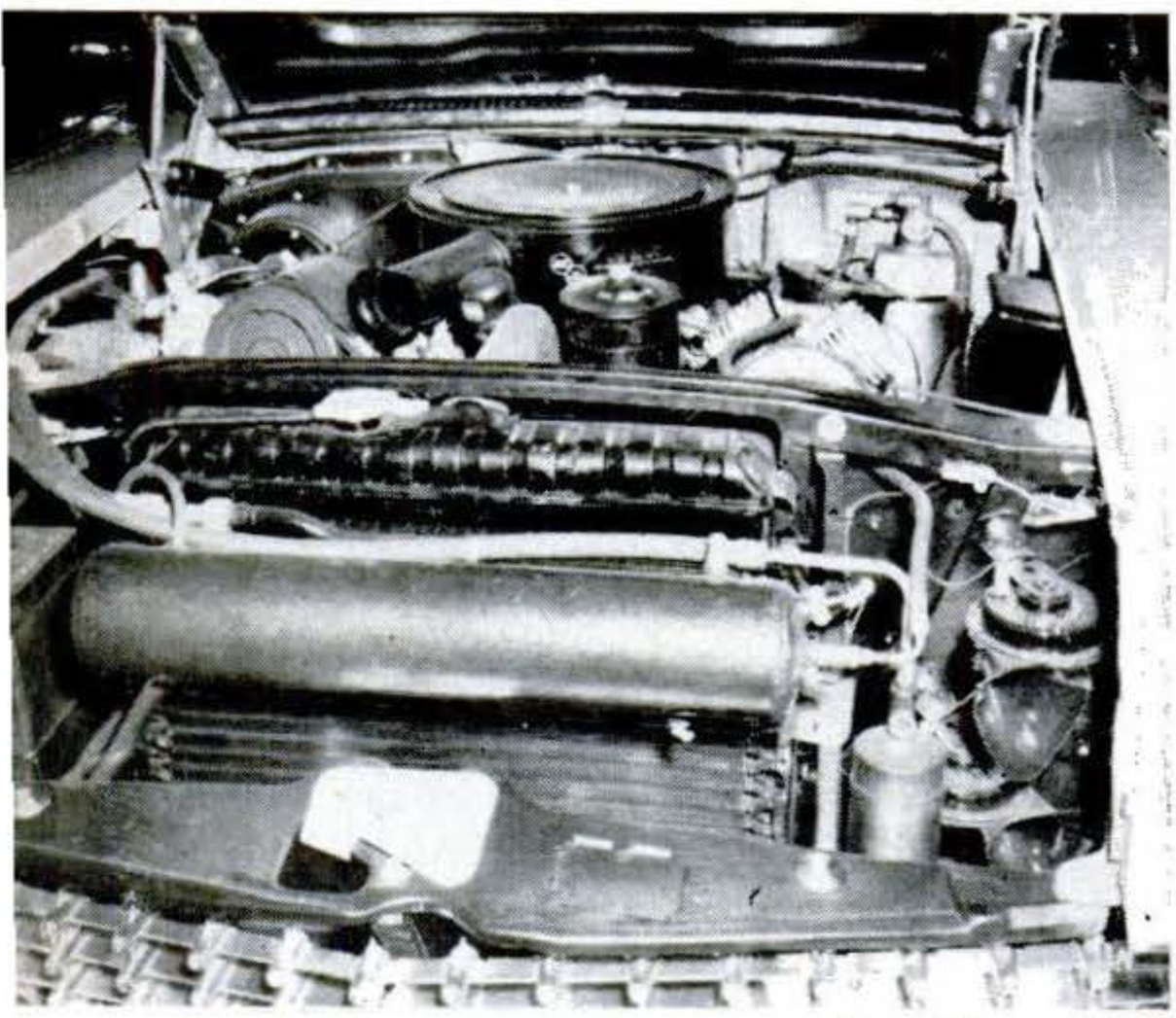


Cadillac's Extended Deck Sedan, with lengthened hood and fenders, jeweled grille and chrome

Why They Stretched the Caddy Hood



ALL THOSE 315 HORSES are comfortably stabled under the bigger hood. Engine displacement of 365 cubic inches is unchanged but compression ratio is boosted from 10:1 to 10.25:1. Valves are bigger, fuel economy better. Cylinder in front of radiator is the reservoir for optional air springs—standard, however, on Brougham.

Caddy, vintage 1957—the hood was too short.

THERE are some people at 2860 Clark Street in the city of Detroit, where Cadillac cars are made, who have aching ears. Their ears hurt on account of some unkind remarks made to them in the last twelvemonth by their customers. This situation resulted in an important change in the Cadillac for 1958.

Last year the Cadillac people thought it would be a dandy idea if they increased over-the-hood visibility for the driver. So they shortened the hood. Things came out pretty nice. A motorist could see a lot more of the road. The Cadillac people were pleased with themselves.

Then, whammy! The customers got

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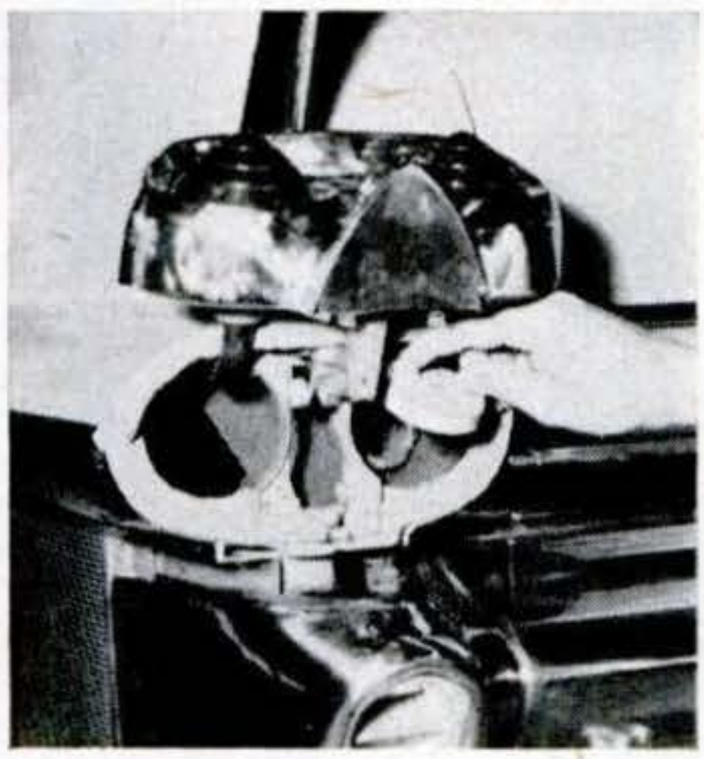
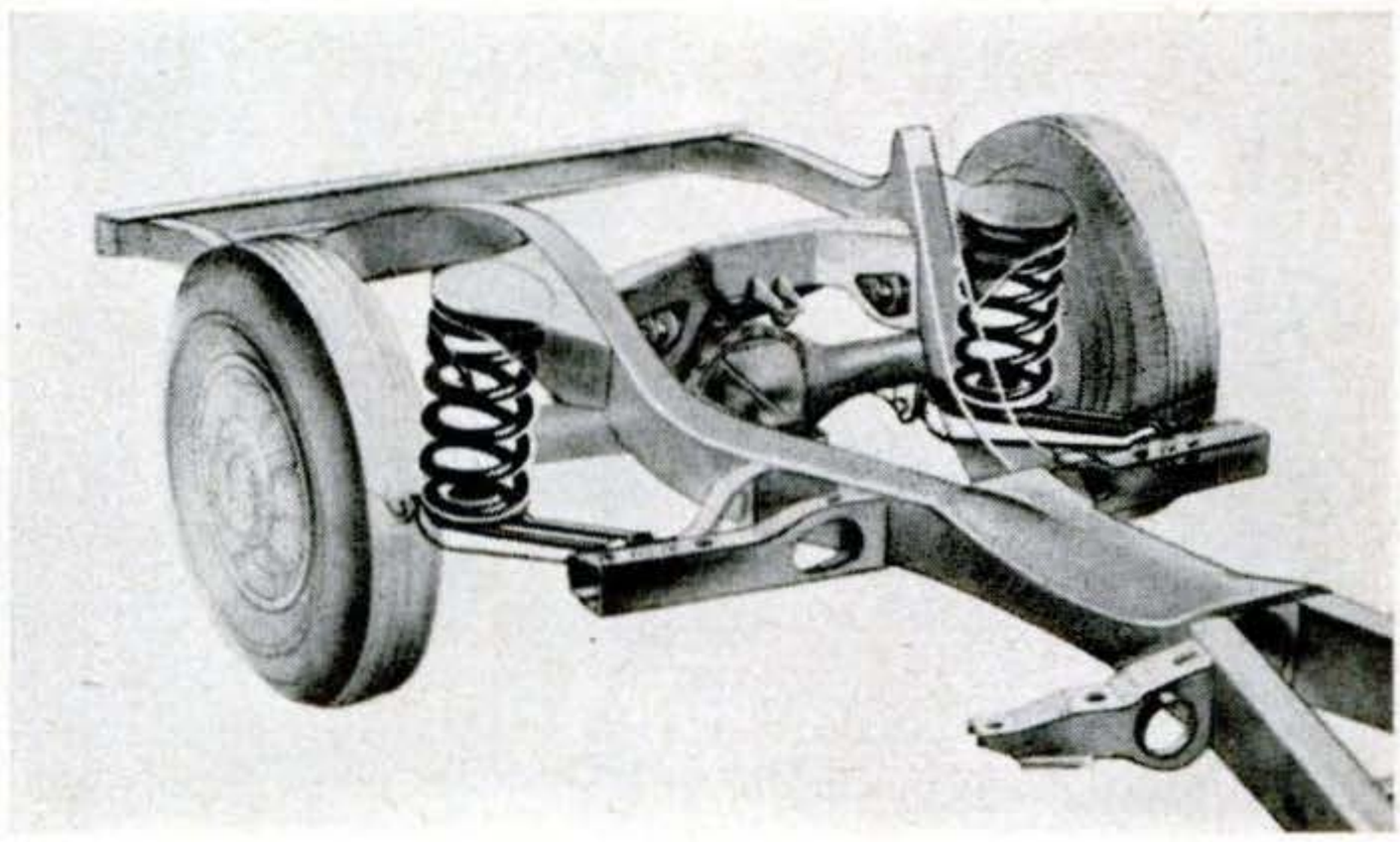
speed lines—all 18 feet, nine inches of her—sits regally for her 1958 portrait.



FUEL FILLER PIPE in Series 60 is located behind the inboard lamp of its twin running lights.



Splaying out frame's rear legs removes humps from trunk floor.

sore. Better visibility? No, siree! They wanted the hood longer. Gave them a feeling of power.

How did the Cadillac people dare put a dinky little hood on a great, big powerful car?

Well, the first rule of business is that you don't spit in the customer's eye. So for 1958, the Cadillac people lengthened the hood by almost five inches. The visibility from the driver's seat is down, of course, but the customers will be happy again.

They will be even happier to discover that the new Caddy's front fenders are four inches longer. Again, less visibility, but think of all that lovely sheet metal out front!

The people at 2860 Clark Street have reluctantly decided to take the world not as they want it, but as it is.

On these pages is the Cadillac as the customers demanded it.

The car not only looks more powerful, it actually is—315 horses compared with 300 for 1957, and an option that goes clear up to 335. All the new Caddies have those longer tail fins, originated on the Brougham. The X frame is revised, and—naturally—there's optional air suspension, pioneered by Cadillac, on all models.

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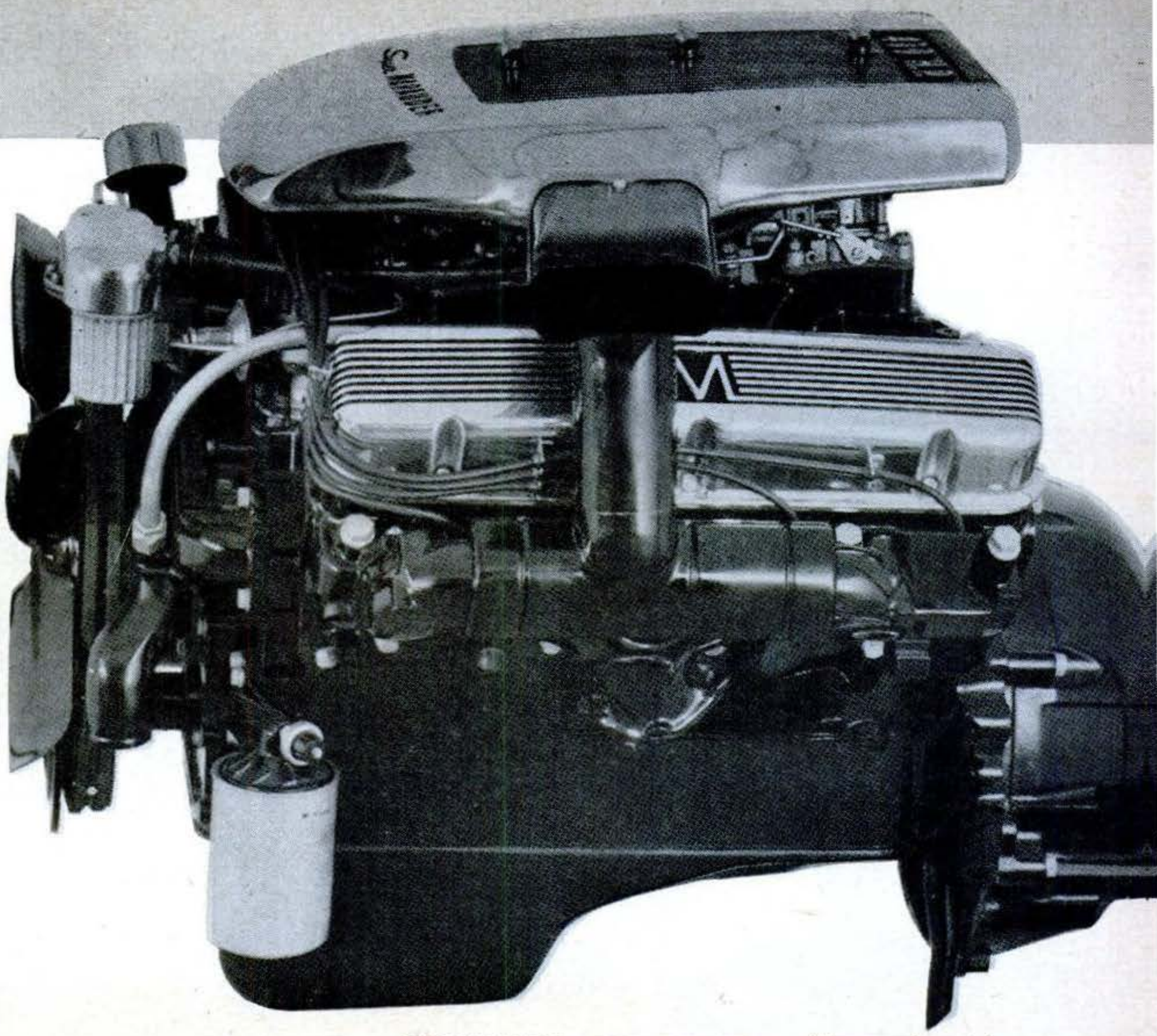
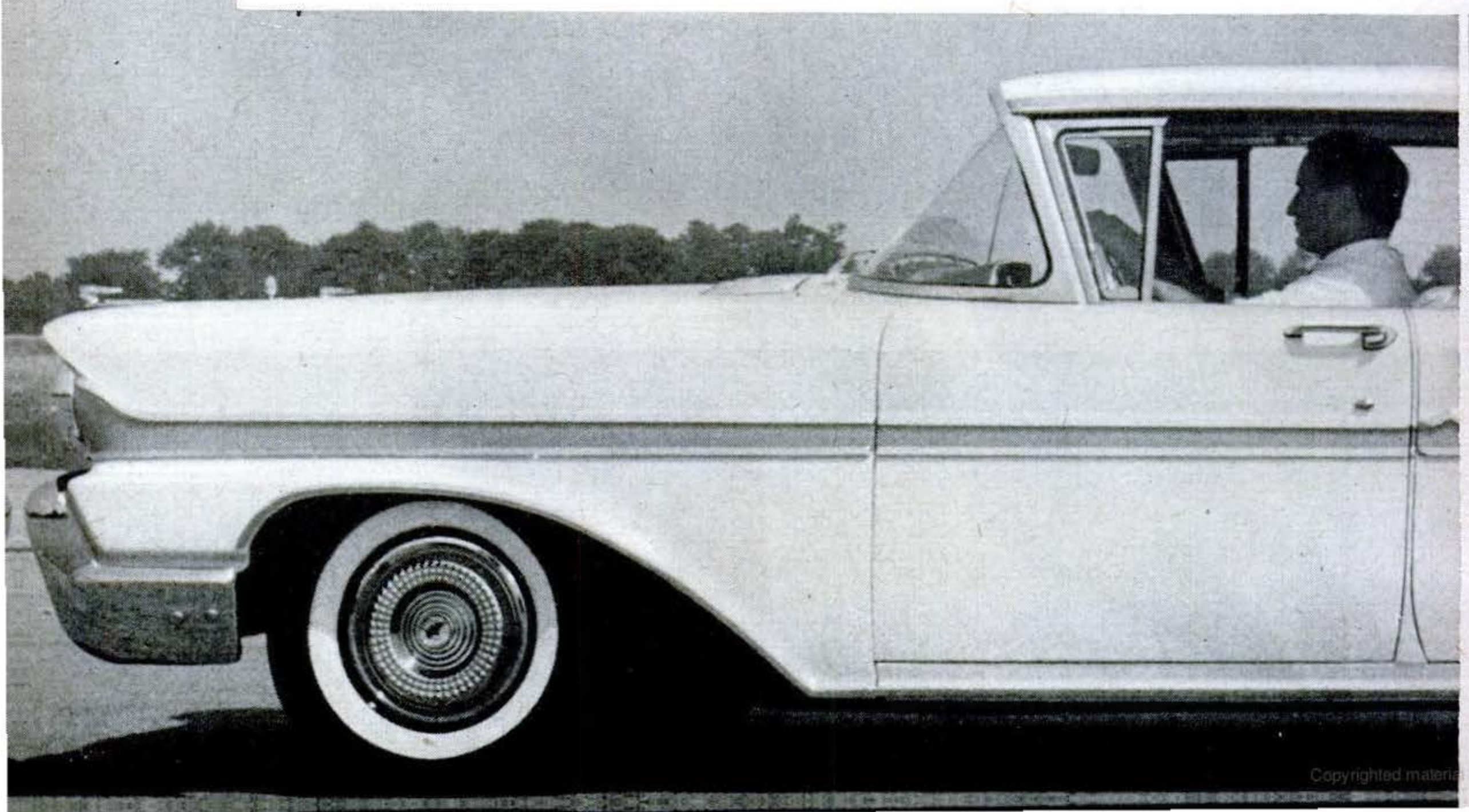


The 400-hp. Marauder

MODERNISTIC AIR INTAKE emblazoned with "400 H. P." squats over three two-barrel pots on the most powerful of U. S. production auto engines. Besides a high-performance cam, the new engine's shortened intake piping, fully jacketed with cooling water for denser air charge, helps deliver the mammoth power output.



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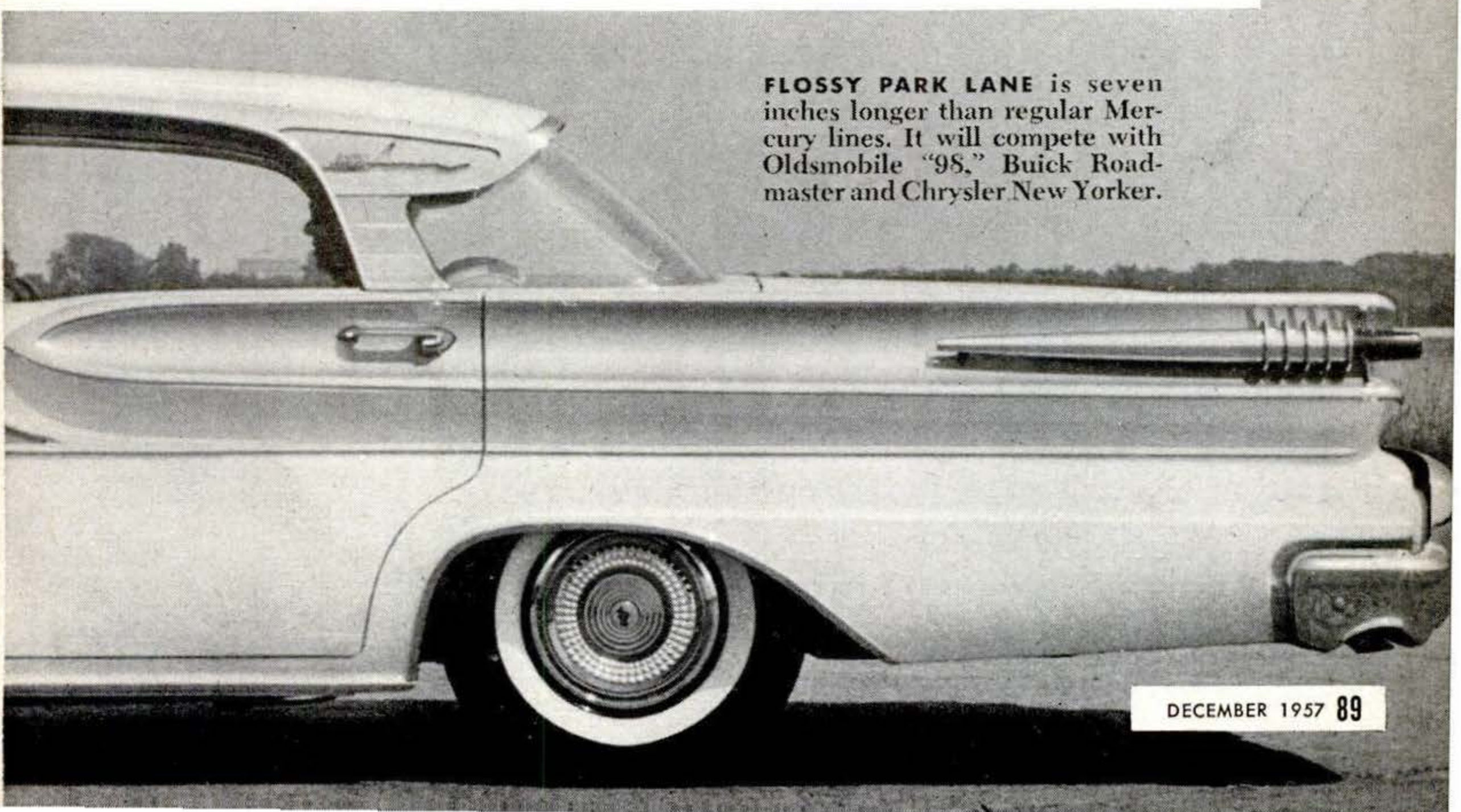
Where Mercury Got Those 400 Horses

It has Lincoln's piston displacement —the industry's biggest—plus a hot cam, three carburetors and WHOOSH!

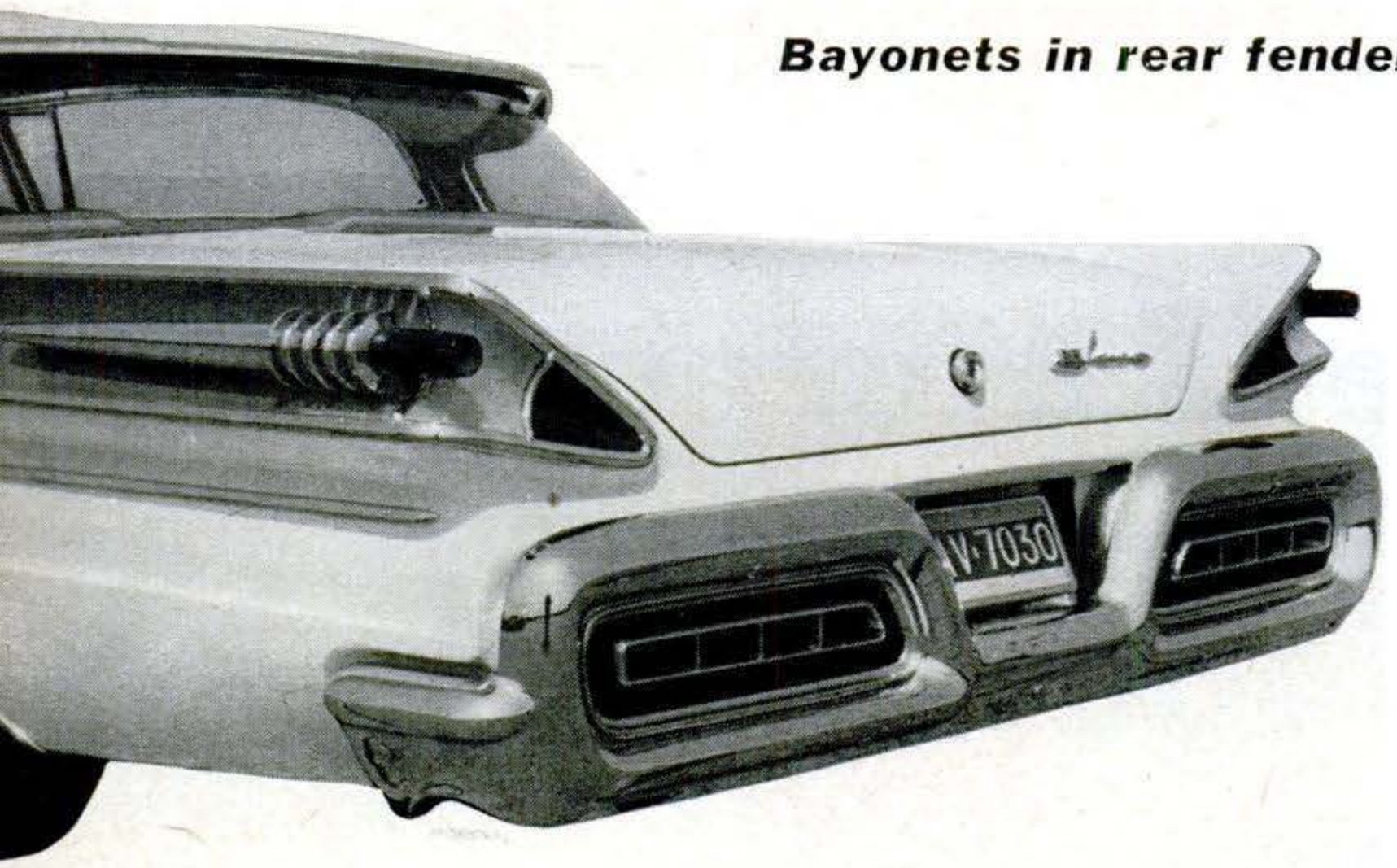
WHEN the features of Ford Motor's new Mercury automobile were announced last month, there was a mouth-watering treat for the customer covetous of *whoosh!*—a 400-horsepower engine. This is 65 horsepower more than you get in the mightiest of the new Cadillacs.

It is 55 horsepower more than Chrysler puts into its plush Imperials,



FLOSSY PARK LANE is seven inches longer than regular Mercury lines. It will compete with Oldsmobile "98," Buick Roadmaster and Chrysler New Yorker.

Bayonets in rear fenders and wings on the



OUTRIGGER running lights—of bayonet design—are 30 inches long in Park Lane series, which has overall length of 220 inches. Same lights in Monterey and Montclair are shorter. Axle ratios go down as far as 2.69:1 to take advantage of greater engine torque and effect fuel economies.

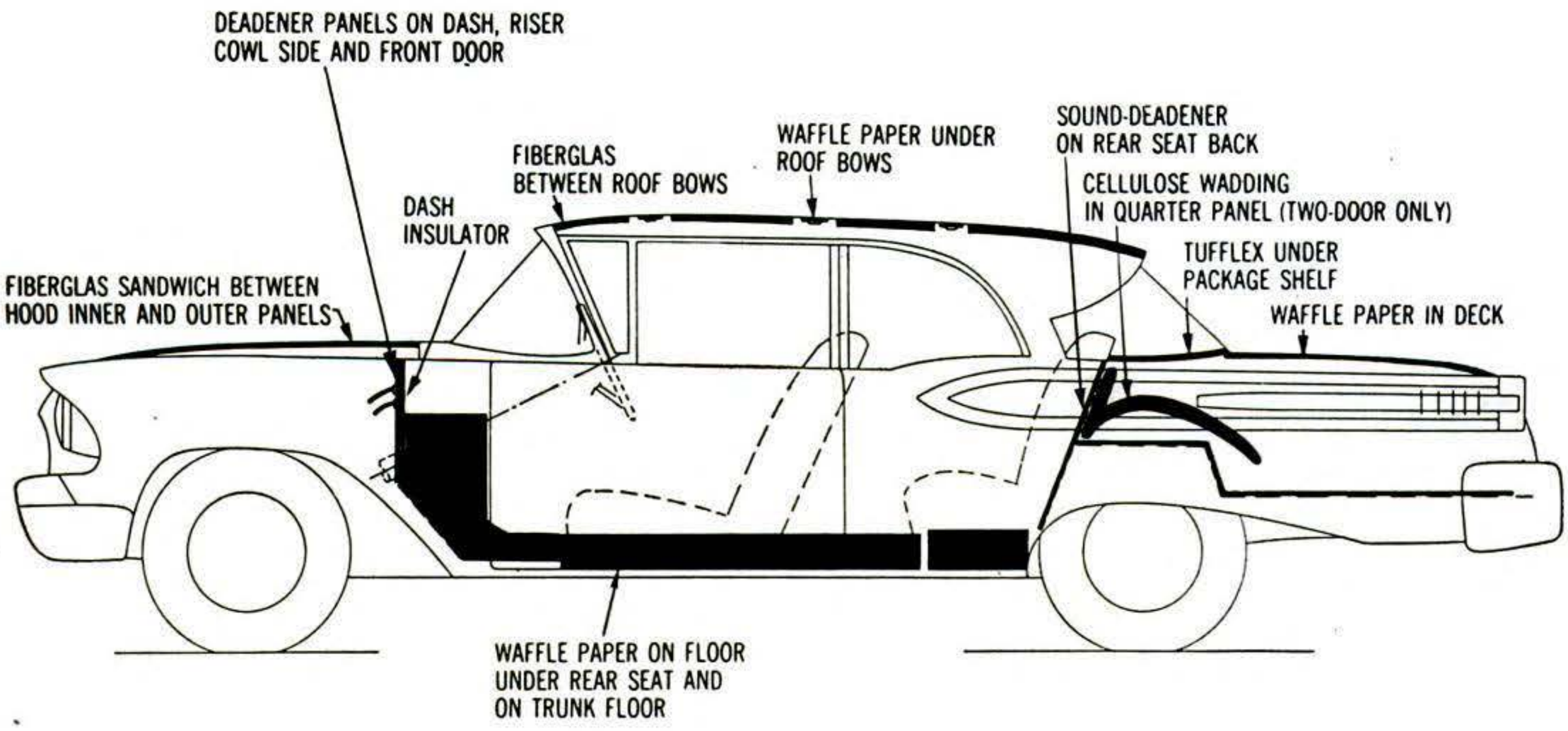
and 10 horsepower more than in the latest issues of the Chrysler 300—with fuel injection.

Mercury didn't say why all the horsepower. It only said how.

The engine is a product of the biggest block in the Ford family. It displaces 430 cubic inches. It's the same block, same displacement, used in the Lincoln. It's also the same block, bored to 410 cubic inches, that produces 345 horsepower in the Edsel's two top lines: the Corsair and Citation.

Mercury has nudged 400 horsepower from the block with a different cam—and a resulting higher r.p.m.—plus three two-barrel carburetors. The engine turns 5,200 revolutions at top output. That's 600 more than Mercury's second-best engine which, with the same displacement and compression ratio, produces 360 horsepower.

Overshadowed by this new engine is news of Mercury that otherwise would be of considerable importance: There's a jack-rabbit transmission, air suspension and (of course) four headlights. And there's a new series, longer and swankier than the Monterey and Montclair: the Park Lane.



Body sound-deadening material is like that used in atomic submarines for noise insulation.

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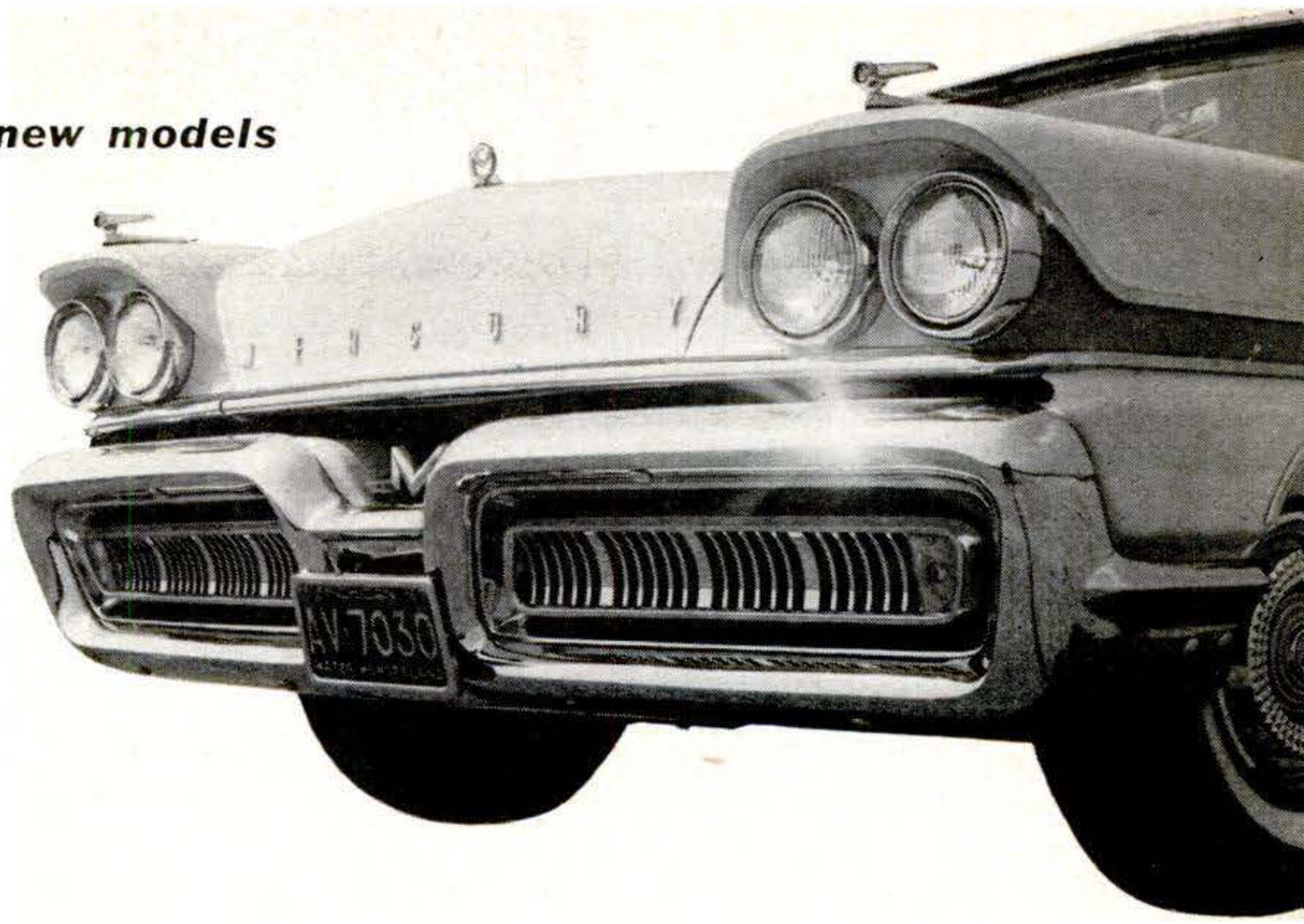
front decorate 20 new models



LOWER HOOD and four headlights make for wide look. Reservoir for air springs at pressure of 300 pounds per square inch is behind and below right headlight. Engine options: two blocks of 383 cu. in. producing 312 and 330 hp., plus the two 430-cu.-in. blocks. All have 10.5:1 compression.

Starting next month:

PS Staff Writer's Eyewitness Report on Russian Technology

Does Sputnik mean that the Russians are ahead of us in other fields of science and engineering? What about the everyday products of their modern technology? How do their automobiles compare with ours? How good are their new roads? What's their TV like? Do they have home workshops and power tools? What kind of household appliances?

When Sputnik began beep-beeping to a chilled world the Soviet challenge to American know-how, a Popular Science staff writer, Senior Editor Harry Walton, was completing a 4,000-mile automobile tour of some of Russia's most important industrial areas. He's one of the first American magazine reporters to get a close look at the way ordinary Russians, outside of Moscow, live and work in this age of earth satellites and intercontinental missiles.

You'll want to watch for the first of Harry Walton's exclusive, first-hand reports on modern Russia . . .

. . . in Popular Science for January

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$150,000 Car Shows

Here's a dreamboat with a different purpose—to protect you and your passengers like eggs in a crashproof crate

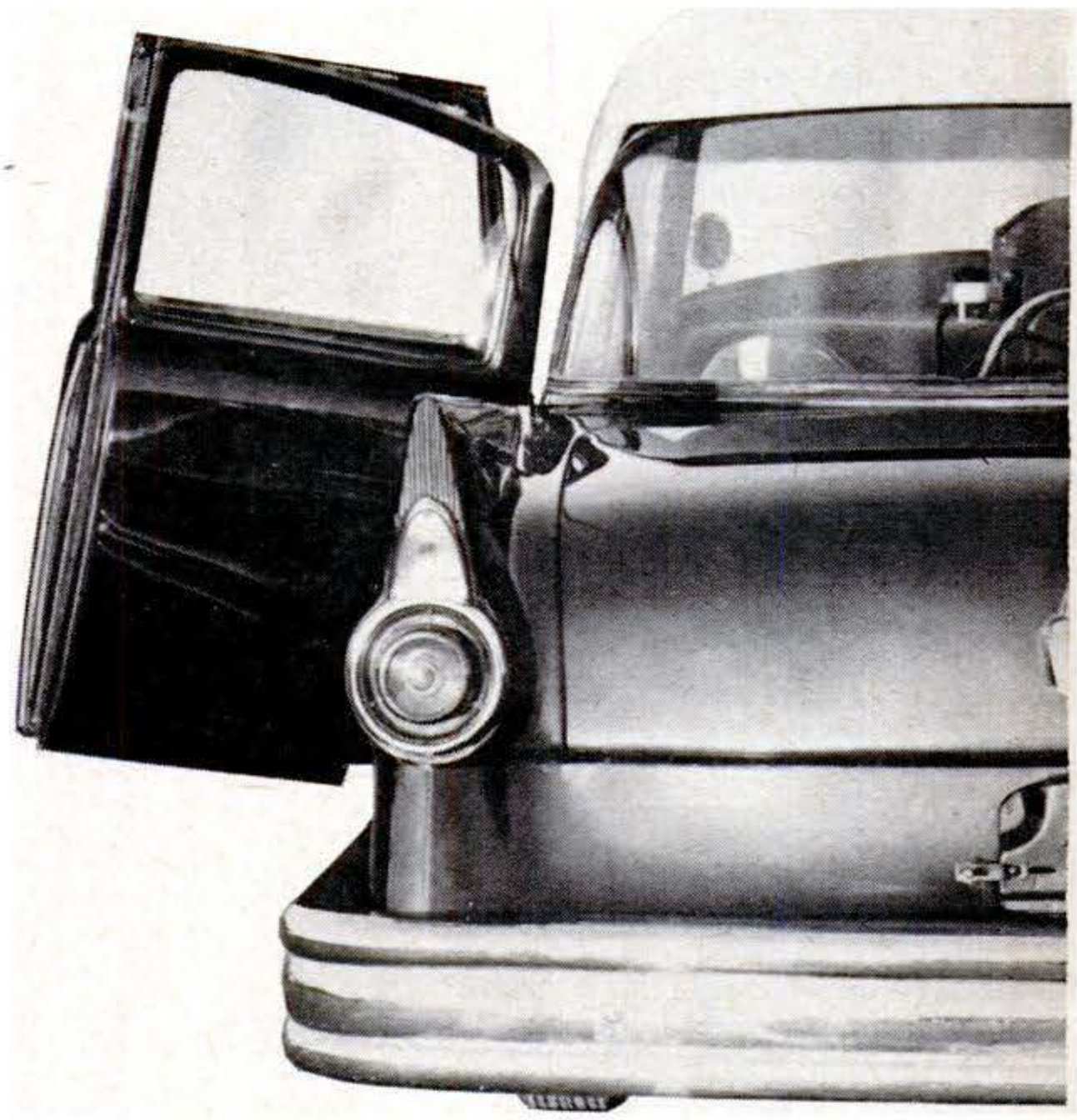
A MAN who bumped his head has designed what is probably the safest automobile in the world. Its name: the Safety Car. You can see it soon. It'll be shown in cities like New York and Boston first, then probably in auto-display rooms in smaller towns.

Its manufacturers—the Liberty Mutual Insurance Co. and the Cornell Aeronautical Laboratory—have only this one auto in their 1958 line. They have spent $150,000 to produce it.

Outside, it's a streamlined, two-door, two-tone green sedan, not unlike other autos. Inside, you'll see why it cost so much: It contains more new ideas than any car you ever saw.

The man most responsible for these ideas is Edward R. Dye, 55, head of Cornell Lab's Safety Research Department. Dye doesn't expect Detroit to snap up his car and produce it. Instead, he hopes the manufacturers will pick up and incorporate the car's ideas—all of them aimed at making passengers safer.

"Take the driver's seat," Dye said. All the seats in the car are bucket seats—to keep you from being tossed around in an accident—and they looked uncomfortable



FOLDING DOUBLE DOORS provide fullest possible access to inside of new Safety Car, do not stick out into road as far as many doors. Closed, they are locked into place by metal bars, cannot

CENTER BACK SEAT faces to the rear, is child-size. Boy, resting head against soft pad, is in what is probably the safest seat in the car. Shelf behind the back seat is hollowed out below top of the seat back. This keeps packages from being hurled out in case of sudden stop.

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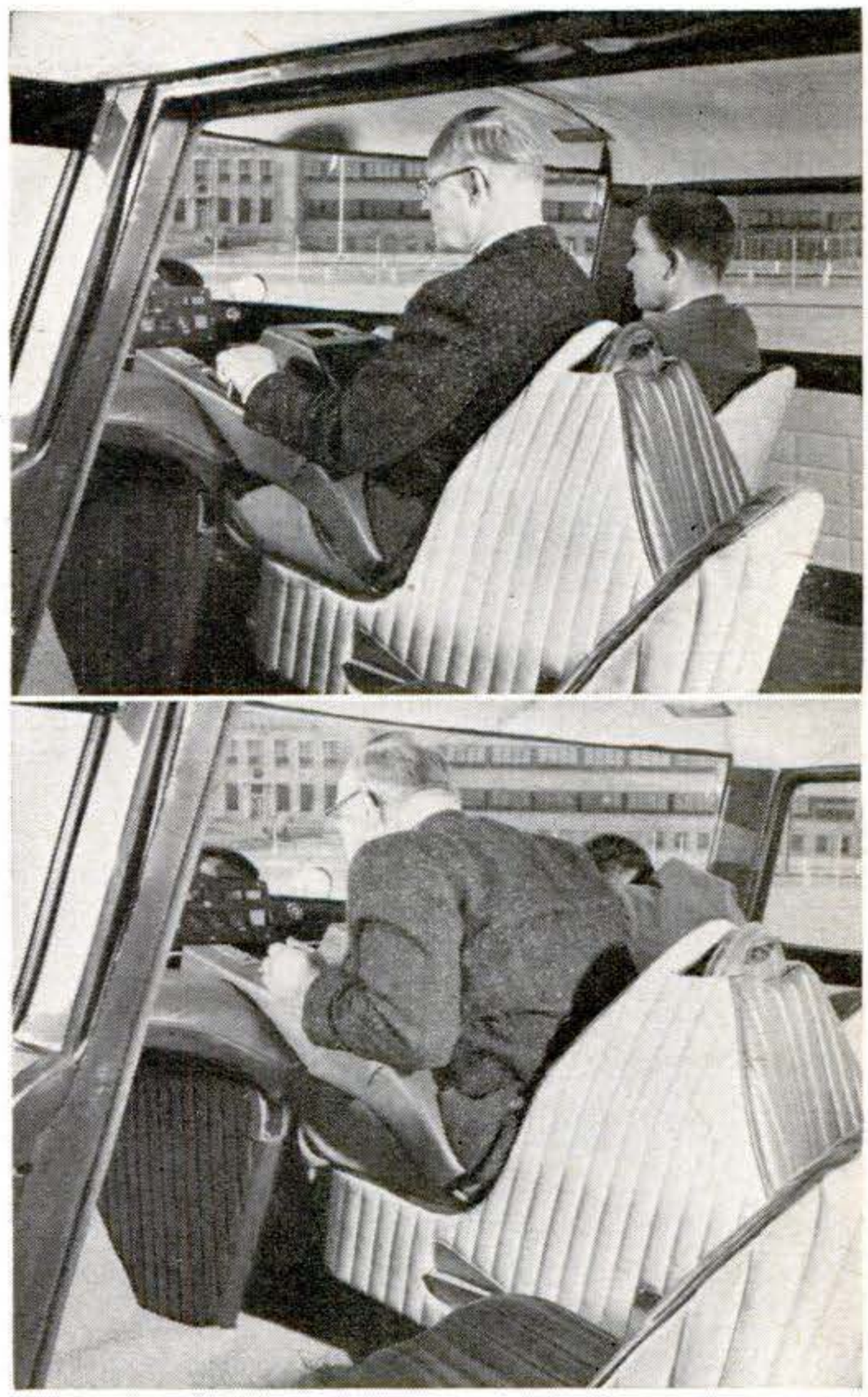
Way to Safer Design

By Gardner Soule

come open in a crash. Rounded rear bumper tends to turn dangerous smashes into glancing blows. Wide rear window adds visibility. The car is painted dark green with white top.



DRIVER (above) sits in the center of car for greatest protection, best view. Front-seat riders are belted in; in a crash they would be held in place snugly, as the bottom photo shows.

LIGHTS BENEATH CAR are to make it visible from the side at night. Front and rear bumpers wrap around. There is also a bumper all along each side. All bumpers are mounted on shock absorbers containing springy, plastic material to increase shock absorption in case of collision.

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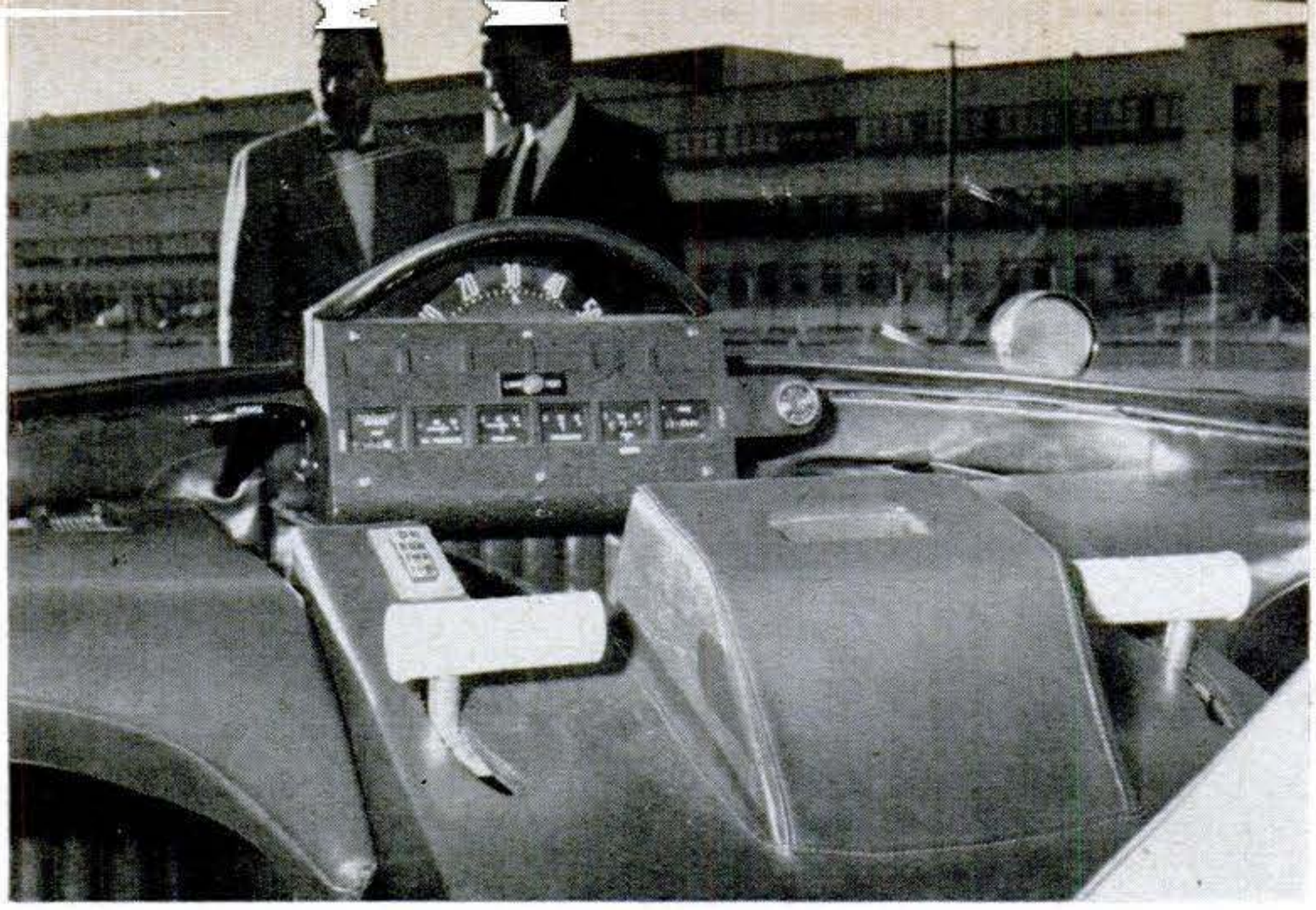

TWO HANDLES guide the car—there is no wheel. Handles are on a padded panel held in place in driver's lap. Switches above left-hand handle are for lights; similar switches, not shown, at driver's right, control driving speeds. Car's speed is shown in direct range of vision as driver keeps eyes on road. Beneath speedometer, other instruments show mileage, oil pressure, temperature, battery charging, fuel, time.

but were not. The seat held me firmly.

"Pull down the driving panel," Dye told me. The most startling thing about the Safety Car is how you drive it. The driver's seat is in the middle—not at the side. This protects the driver from side blows, gives him better control, lets him keep little accidents from becoming big ones. The driving panel, which replaces the steering wheel, rocks down from the dashboard and locks into place just above your lap.

The steering wheel has vanished from the Safety Car because the Cornell Medical College reported that the wheel, either by means of a broken rim or the steering post itself, was a lethal instrument.

"Place your hands here." Dye pointed to two small handles, each about as long as the grips on bicycle handles, mounted out toward each side of the driving panel. "You don't have to steer," said Dye. "You merely guide. This you do by moving either handle slightly forward or backward—a tiller-like motion. Try it." The car has power steering and the front wheels turned easily.

I thought the feeling of sitting behind the driver's panel much like that of sitting at a desk. Your arms are held naturally, lightly and easily on the panel.

Ignition key and starter are at the right, ahead of the panel on the dash. Dye showed me the horn button. It's right under your thumb, on the right-hand steering handle. In the corresponding end of the left-hand handle is your light dimmer. Recessed, spring-mounted buttons on the panel control driving range and lights. The buttons can't harm you in a crash even if you strike them hard. Similar, no-harm-possible buttons, in the right-hand wall of the car, run the radio. In the front left-hand side, other buttons control heating and ventilating. Inside door handles fold flat and out of the way.

The driver's seat is slightly ahead of, and slightly higher than, the other two front seats. This thronelike arrangement gives the driver an unblocked view on both sides and lets him concentrate on driving.

The only things the driver operates with his feet are the long, hard-to-miss brake, and the accelerator.

The car that took a year to build

THE Liberty Mutual Insurance Co. and the Cornell (University) Aeronautical Laboratory built the Safety Car by hand, and it took workmen a full year to do it. The man here is putting into place a piece of the double floor—double to provide tracks for the doors to run on and for the front seats that move forward and backward for convenience of riders and drivers.

The builders started with a 1955 Ford, and made it over. The cowl area was lengthened by the dark panels beneath the windshield. This allowed the windshield to curve gently, with the least distortion. Light lines over the windshield are arms that will swing wiper blades that clear entire windshield. The arms are covered by the roof in the finished auto. Folding doors were made to open almost the whole width shown.

At front and rear of doors, steel roll-over bars are incorporated into the body. These are strong enough to support 3½ times the car's weight in an overturn, and arch directly over the riders' heads.

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SEAT BELT snaps closed easily to hold back-seat rider in place. Everyone in Safety Car is buckled in. Bucket seats also help. There is padding in ceiling, sides, floor, backs of seats, everywhere. Concept of car is that of a package designed to protect fragile goods—people—in any possible crash. Experts believe you could sail into a telephone pole at 50 miles an hour in the Cornell car and step out the door unscathed.

The other two front seats also have desklike panels that lock in place in front of the riders and provide armrests, although they do not, of course, have driving controls. Each of the three front-seat panels has two arms that hug you on each side. Between the arms is a seat belt. Back seats also have retractable belts.

Dye regards the Safety Car as his masterpiece, and the ideas in it represent 30 years of work and study on his part. Back in the 1920s, when he was playing football at Purdue, he got a couple of bad whacks on the head. This led him to study kinematics—the science of bodies in motion. And it led to his designing new injury-reducing helmets for Cornell footballers, and safety matting for boxers and wrestlers to land on.

A box to protect eggs in transit was perfected later by Dye. You can toss it against a wall and not crack a shell. Then, thinking that the human head was like an egg—soft matter surrounded by a shell—he built, with help from Liberty Mutual, the Safety Car. The man who made travel safe for eggs now believes he's made travel safer for you. END

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Science Closes In on

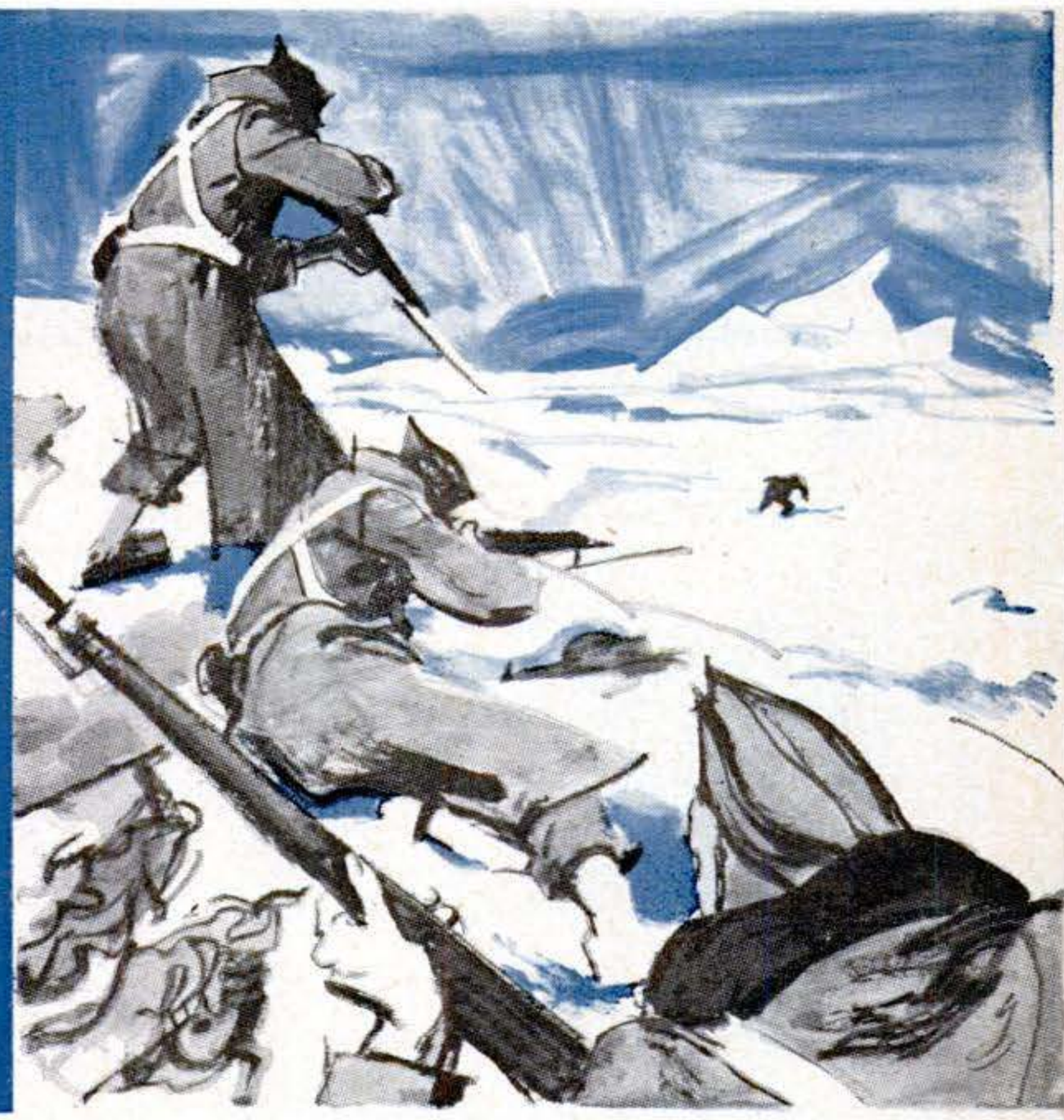
Will 1958 see the capture of the mysterious creature that mountaineers have hunted for nearly 70 years?

THE longest game of hide-and-seek on record is being played on the roof of the world: in the highest Himalayas. It has gone on, so far, for 68 years. The seekers are men, including today's best Himalayan explorers. The hider is an unknown man or beast—one? several?—that makes mysterious anthropoid footprints in the icy snows blanketing the world's ceiling (PS, Dec. '52).

No Western men have had more than a glimpse of this unknown creature they call the Abominable Snowman. But though explorers and mountaineers cannot find the snowman, it has shown an amazing ability to find *them*.

In 1951, Dr. G. N. Dutt, resting near Everest, looked up to see that he was being stared at by a creature with grizzly brown hair on its head, apparently a snowman. The beast promptly vanished. In 1952, the Swiss expedition that almost climbed Everest heard the snowman's yelps, tantalizingly near—but the snowman stayed hidden by fog. Another near-miss. In 1953, the British, on their way to the first successful ascent of Everest, heard another snowman sound: a

1889: World's most startling tracks Just as soon as Western man penetrated earth's highest places, he was shocked to find bare manlike prints in the snow. Col. L. A. Waddell first discovered them, 16,000 feet up, in Sikkim. How could a man live in those frigid winds? Yet there was the proof: Something or someone was walking across the roof of the world.



1890s: The body no one identified One near-miss kept the mystery from being cleared up at the start. Workers on a telegraph line near Jelap La (a pass) disappeared. British troops searched the area, shot and killed a wild, shaggy-haired apelike beast. But they left the corpse in the mountains; no scientist was there to look it over and identify it. There was only an army report.

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'Wild Man' of Everest

whistling cry. Again the snowman stayed invisible. In 1954 and 1957, the snowman —by now perhaps the most-wanted quarry of any chase—eluded expeditions sent out expressly to bring him back.

In fact, the snowman has displayed its tracks, sometimes very fresh ones, to almost every Himalayan expedition of the 1950s. Two Europeans in 1948 actually came to hand-to-hand grips with the snowman. This ghost of the Himalayas has been called a bear, monkey, panda, ape, yak, horse, musk deer, lynx, snow leopard, wolf. No identification has stuck. For one thing, the humanlike tracks appear at far greater heights than the known ranges of any of these animals.

But what if some familiar animal has got beyond its recorded range, straying into the snowy heights? To answer that question, the London Zoo made live tests. It recruited animals native to the Himalayas and studied the imprint of their tracks in wet sand. Himalayan bears were quickly eliminated. Better clues came from animals most nearly resembling man. The closest likeness was the langur monkey. But its tracks were not nearly so big as the snowman's.

Starting in 1958, more nations than ever —including the U. S., Britain, Switzerland, Italy—will send expeditions into the Himalayas. All will watch for the manlike beast. Will they succeed where three generations of explorers before them have failed? Here is the story up to now.

1921: Guardian of Everest Englishmen first tried to climb Mount Everest in 1921. Lt. Col. C. K. Howard-Bury, their leader, saw tracks "like those of a barefooted man"—made, his porters told him, by "the wild men of the snows." The yeti (snowmen) live, the natives said, in the highest places; some on the peaks themselves. One, they thought, guarded Mount Everest.

1925: A witness who couldn't believe it A. N. Tombazi, in Sikkim (where Col. Waddell first found the tracks), saw a "figure exactly like a human being's . . ." Afterward: ". . . I examined the footprints . . . in shape like those of a man . . ." Tombazi, amazed, knew he might not be believed. So he published his report privately. [*Please turn the page*]

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1937: The steps cut in the ice Famous climber John Hunt probed the difficult and dangerous Zemu gap. He was startled to find two lines of the manlike prints winding their way through the mountains. He was more startled to find that steps had been cut into an ice slope. He used the steps himself. He assumed climbers had been there, was bewildered to learn none had been anywhere near.

1948: The man a snowman bit World War II halted the search for the snowman for 10 years. But in 1948, two Norwegian engineers, Aage Thorberg and Jan Frostis, sought uranium in the Zemu glacier. Suddenly two dark, hairy beasts—looking, they said, like giant monkeys—set upon them. One bit Frostis' shoulder. Both men were dazed but tried to lasso the sinister creatures. They failed.

1953: "Sometimes on all fours" En route to Everest with his party that climbed it, John Hunt, the leader, stopped at a monastery. Monks said a snowman had been there and had hung around for several days. From inside the monastery, they had watched it. Sometimes it walked upright, sometimes on all fours. The monks finally scared it away by blowing on their long horns.

1954: A human characteristic On a snowman-hunting party, Charles Stonor followed tracks close enough behind a snowman to get a possible clue to his diet. Stonor found the remains of a hare. It had been disemboweled. No beast or bird of prey leaves the entrails of its kill. This is a human trait. It suggests that the snowman might be a missing link, a primitive man, or much-advanced great ape.

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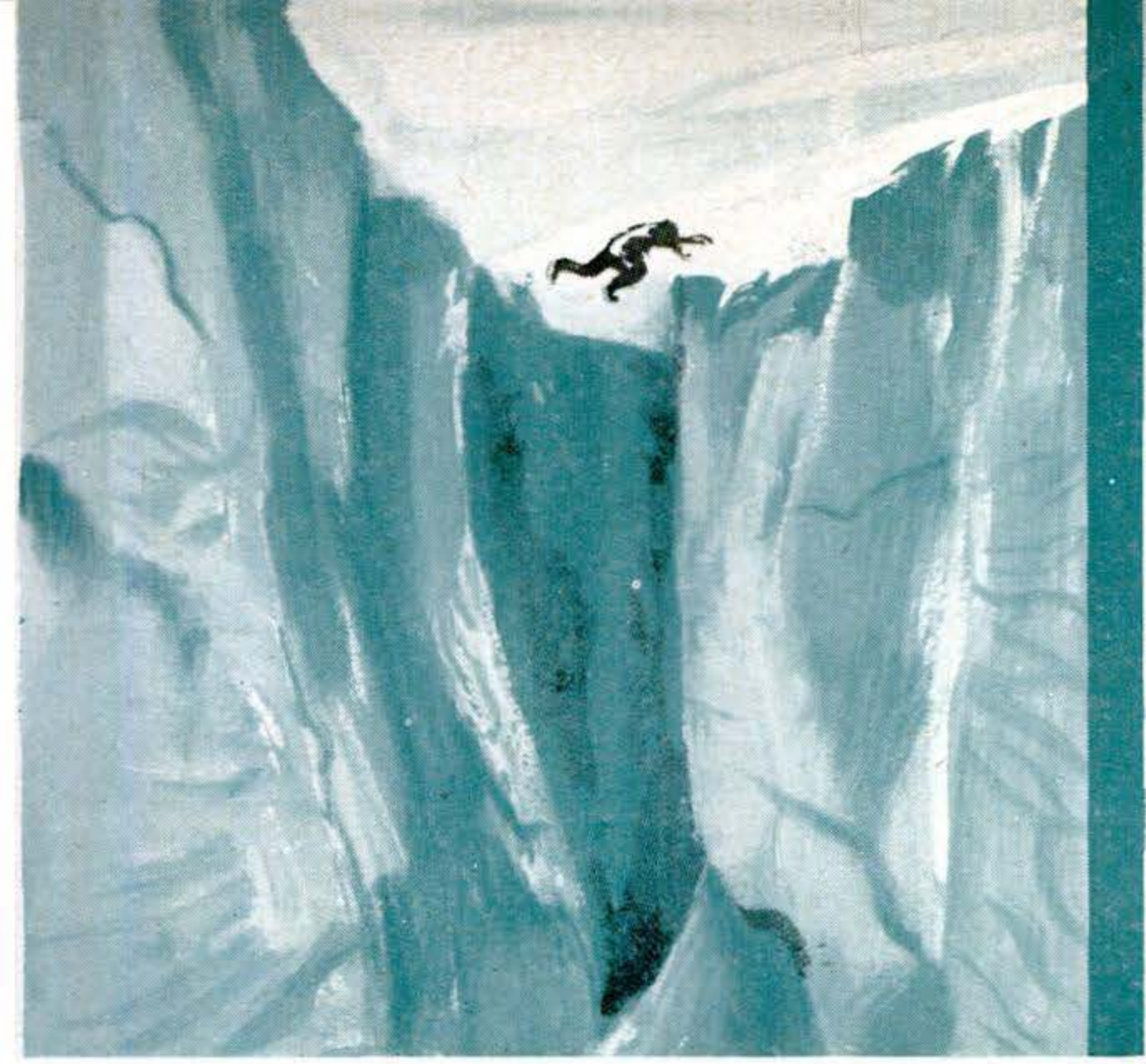
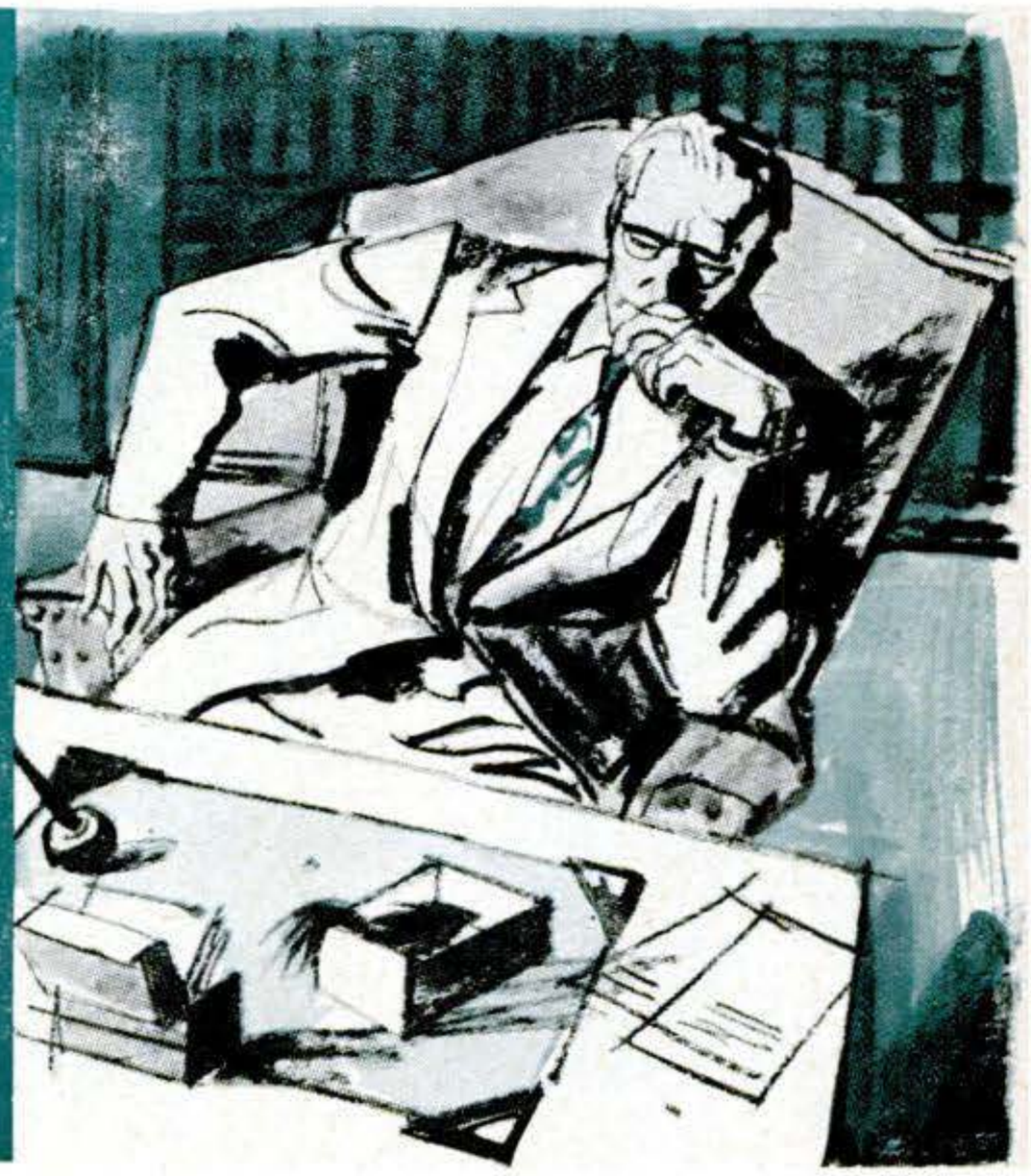


1951: Snowman leaps a crevasse Another near-miss came when famed Himalayan explorer Eric Shipton found fresh tracks at 19,000 feet, brought back convincing photos. He followed the trail for several miles, the longest set of tracks yet—to lose it on rock and debris. One track showed the creature's great climbing ability. The yeti had jumped a wide chasm, anchored itself on the other side.

1952: Hillary misses a chance Edmund Hillary was climbing in the Himalayas when his Sherpa guide, Ang Pemba, picked up a tuft of long black hairs—thick and coarse. "Yeti, Sahib, yeti!" cried Pemba. Hillary wanted to bring back the tuft for analysis. But Pemba threw it over a bluff. It would be bad luck, the Tibetan guide said, to keep it; it would make the snowman angry at the Sherpa tribe.

1954: Found—a look-alike Stonor showed native Sherpas photographs of orangutans and many other animals so the Sherpas, many of whom claim to have seen the snowman, might point out any similar creature. Some at once called the pictures of orangutans those of snowmen. Others said the snowman looked like orangutans—but wasn't quite the same. No other animal was even considered.



1955-8: "Proof will be found" Zoologist Leon August Hausman of Rutgers U. (N.J.) studied an alleged snowman scalp, said it belonged to an unknown mammal. In 1957, a Texas party searched for the snowman and found none. But, says Sir John Hunt: "I believe in the yeti. I have seen its tracks, heard its yelping call." Proof to answer doubts, says Hunt, is only a matter of time. END

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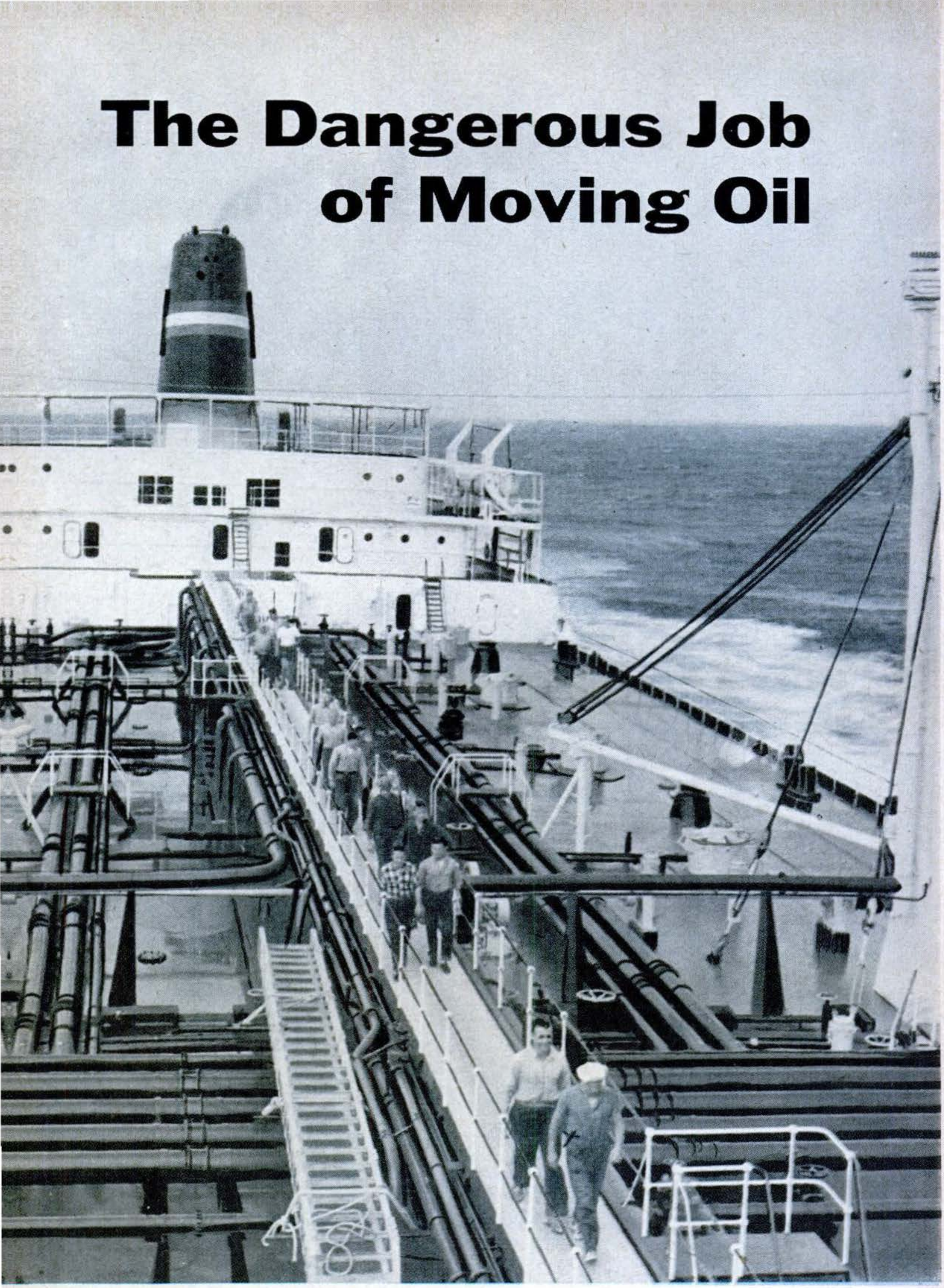
The Dangerous Job of Moving Oil



Morning parade along catwalk is to bosun's locker for clean-up gear to keep tanker shipshape.

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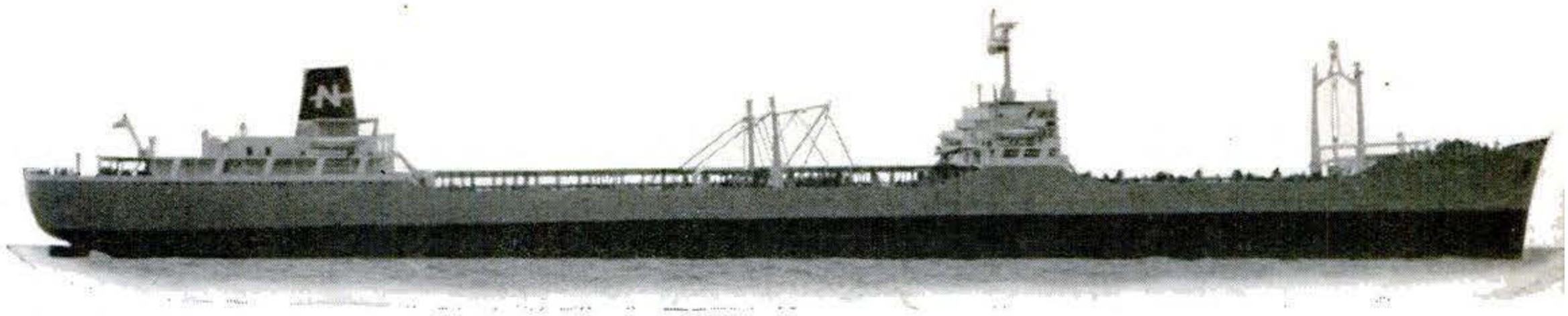


With 45,000 tons of explosive cargo, this giant tanker sails the seas to help quench the world's insatiable thirst for oil

By David R. Lindsay

IT WAS 0236 on a star-filled morning when two tugs nosed the bow of the largest cargo vessel ever built in the United States into the slip at Amuay Bay, Venezuela. The pilot, who had never seen so huge a vessel as the new supertanker World Beauty, played it safe and had her dead in the water when she was only part way in. Then her mooring winch took over, pulling her in by her tree-thick lines. Too long for the dock, she stuck out into the bay astern and her midship connections missed the loading station by a couple of hose lengths. The Beauty's overall length is 736 feet, more than twice as long as two football fields. Her beam of 102 feet got her a two-vessel slip to herself.

The floodlights on the pier and the chains of bright white lights on the refinery on the hill added a look of urgency. Because so many major oil fields are located in far corners—the edge of South America, the Arabian desert, the East Indian archipelago—the world's 3,000 tankers work around the clock trying to keep up with civilization's thirst for fuel. Oil carriers make up half of the merchant tonnage afloat today and every year the oil fleets expand as bigger and bigger tankers are launched. The reason for the growth in size is economic: The bigger the tanker, the more oil she can carry per dollar of wages and fuel. So today supertankers are the mistresses of the seas. Trailing the World Beauty's chief mate, Martin Meseck, during her maiden voyage, I learned why the life of a modern tankerman is so rugged and exciting.

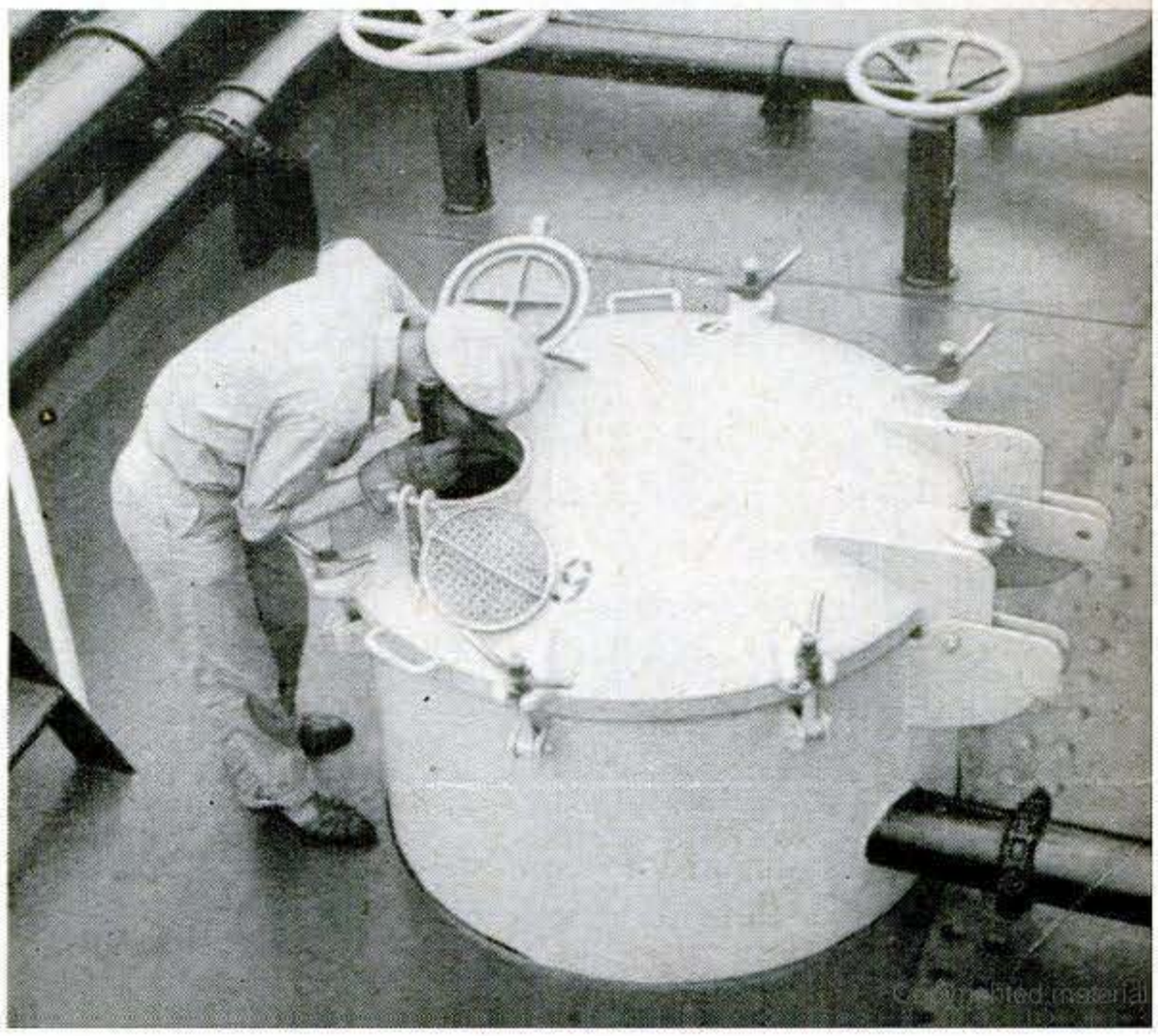
The $12,000,000 World Beauty was less than a week out of her Massachusetts birthplace when she tied up at the Creole Petroleum Corp. dock, but her captain was already fretting. The giant tanker had to swing at anchor for a day and a half while the Amuay storage tanks accumulated enough crude oil to fill her up. At $3,500 a day for operating charges, that's an expensive wait.

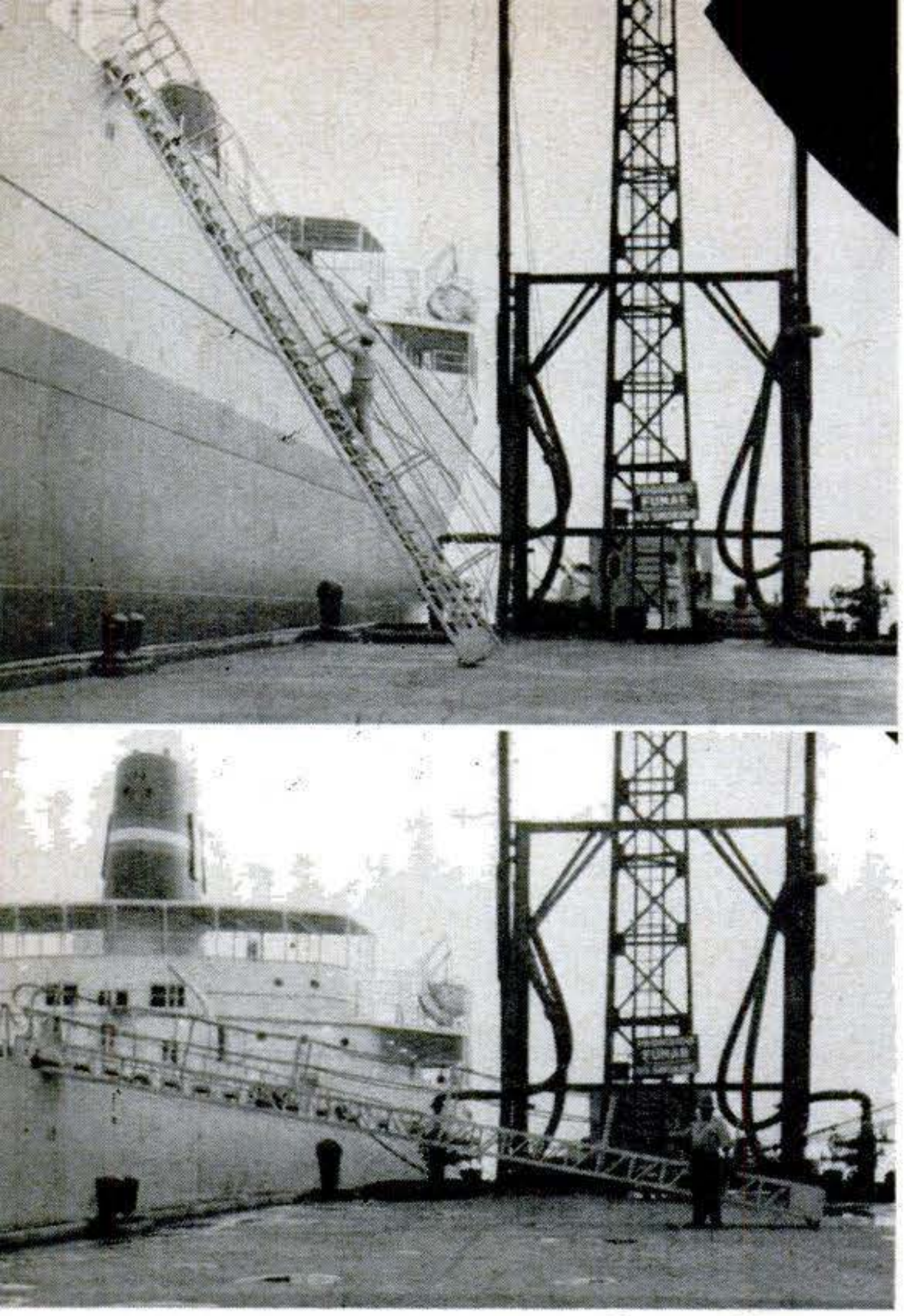
When the mooring lines were secured, Chief Mate Meseck left his docking post on the fo'c'sle. As the ship's general manager, he has one job he can't delegate: watching the loading and unloading of cargo and ballast. To keep the Beauty from blowing around like a balloon, she'd left with half a hullful of Boston harbor water. Now it had to be dumped before the tanks could be filled with oil.

Taking cargo on a tanker is complex and risky, as I'd learned from the disaster stories swapped over the dinner table by Captain Johann Masuch, the chief mate, and the chief engineer. (The conversations were in a combination of English and German. Like many a tanker, the Beauty is practically a United Nations: Built in America for Greek shipping magnate Stavros Niarchos, she flies the Liberian flag, was chartered for this voyage to a British company, and was manned by a German crew.)

Would we have trouble? At Amuay Bay another tanker, the Herbert G. Wiley, had been sunk by a fire and explosion,

CHECKING THE OIL LEVEL: Chief Mate Martin Meseck aims a sparkproof flashlight down a tank hatch as the World Beauty takes on her 45,000-ton liquid cargo at Amuay Bay in Venezuela.





WATER BALLAST PUMPED OUT, the World Beauty rides high above the dock, her gangway almost vertical. As her tanks drink oil, however, she settles deep down into the water.

origin unknown. At nearby Aruba one had been lost when a wrench dropping onto the steel dock had sparked off an explosion.

When disaster strikes, it strikes fast. On March 7 of this year, the Navy tanker Mission San Francisco collided with a small freighter, Elna II, in murky weather in Delaware Bay. The Mission exploded, burned, and sank so fast that 10 tankermen were lost, though the explosion occurred so close to the Delaware coast that street lights on shore were knocked out.

The danger is in the explosive vapors. Crude oil, which the World Beauty was to carry, has components more volatile and inflammable even than gasoline.

An oil carrier, Meseck told me, can't be pumped full all at once because her stern tanks would overflow before her forward ones were full. Instead she has to be loaded tank by tank; valves must be opened and shut with split-second timing. The Beauty would be receiving crude at the rate of a million and a half gallons an

"You could see explosive

hour, rushing through the hoses at 30 to 40 m.p.h. A miscalculation could burst a hose or shoot a geyser of oil mast high, with the possibility of a fiery death for all aboard.

Accompanied by the pumpman, whom he always called "Poomps," Meseck clambered over the black pipelines on deck as he made his way to the pumproom by the after deckhouse. There is a mile of cargo pipe aboard the Beauty. The lines are controlled by 103 valve wheels on deck and another 52 inside the pumproom, which has a Rube Goldbergian tangle of pipes, from 16- and 14-inchers down to tiny gauge tubes. Handles all have brass identification plates and are painted in a color code—yellow rims for cargo valves; black spokes for crossover lines, red for port tanks, etc. But like virtuosos, the two men played the valves without looking. Five minutes after the last mooring line had been made fast came the whine of the turbine pumps discharging ballast.

To stall off trouble, a procession of seamen was moving aft along the deck, carrying large wooden plugs. These they stuck into the scuppers (drain holes) so that oil spilled on deck wouldn't run overboard to spread dangerously across the water.

While the ship's crew was putting the 30-foot gangway over the side, men on the dock were hooking up extra lengths of hose. The empty Beauty rode so high that her gangway became a ladder. Her own cargo booms had to help lift the heavy hoses aboard.

Well after daylight, when it was beginning to get hot, James Ross from the refinery came aboard, and told Meseck what cargo the ship would get: a split load, 13,000 long tons of a premium crude for making lubricating oil and 27,000 tons of ordinary crude.

Meseck was having trouble sucking out the last of the ballast with the stripping pumps. He went down into the tanks themselves. At the bottom of one tank, he found what was wrong: A small piece of sheet metal, left by the builders, was blocking the suction line.

At 0941, with everything set, Meseck gave the word to the men at the dockside to start the oil flowing. He rushed to the

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inspection opening on a tank and looked in. He and Poomps took turns peering down. After a short wait, Poomps spread a red bandanna over the six-inch hole. It fluttered. When the oil starts through the pipelines, it pushes air out and you can feel the wind. Suddenly, at 0944, Meseck and Poomps grinned at each other. The World Beauty's first oil was aboard. You could smell it.

When all the hoses were shaking with oil, the chief mate went to his room to calculate how high to fill the tanks. The only way he can tell how much oil he has is to measure from the top of the liquid to the top of the hatch. Taking these soundings is called "taking the ullages," and the tools are a weighted steel tape for the measurements and a sparkproof flashlight for looking into the unlighted tanks. To reduce sloshing, tanks should be nearly but not quite full. Roughly a foot of air space is left for expansion of the oil.

The captain was disappointed that his ship had been assigned only 40,000 tons of cargo when she could carry nearly 45,000. In answer to a cable, the ship's agents sent word to take a full load. Then Meseck had to do his figuring again, this time taking into account the ship's draft. Engraved on the side plates are Plimsoll marks showing how deeply the ship may be loaded in different oceans at different seasons. Since payment is by the ton, and an inch of draft is equivalent to 142 tons of cargo on the Beauty, the goal was to load to the limit.

That afternoon, while off-watch seamen strolled ashore for a few hours, Meseck had the watch on the go. Men were stationed at ullage openings and valves. As the rising black tide was reported nearing the top of a tank, Meseck, Poomps and several others would converge on that part of the deck. Commands were shouted. Men in pairs spun yellow-painted valve wheels. Poomps darted from hatch to hatch in a permanent crouch.

You could see explosive vapors escaping, like heat waves off a sun-baked road, as Poomps opened ullage holes. Smoking is prohibited on the main deck at any time even though, when the hatches are closed, the vapors are led up pipes to be dissipated 30 feet in the air.

LEAKING OIL, seen as a black smudge under the mate's hands, is an ever-threatening fire hazard. Faulty connections, like this one, are repaired immediately and the oil swabbed up.

Oil was still coming aboard at midnight when a man wheeled on a squeaking supermarket basket of sealed gallon cans. They were oil samples for the refinery at the other end of the trip in case there was any question of contamination of the cargo.

At 0031 the next day (Friday), Meseck told the man on the dock: "Stand by to stop pumping." After checking the draft marks, he called out, "Shut down!" Then he climbed to the bridge and shattered the night with a confirming blast on the ship's whistle.

When the World Beauty got underway at 0242, she'd loaded 44,989 tons of crude oil, the biggest cargo ever carried from Amuay Bay. The chief mate, turning in for a catnap before standing the 0400-0800 watch, had spent a wearing 27 hours on his feet.

Clear of the bay, the World Beauty headed for the Mona Passage out of the Caribbean. Once in the Atlantic she would veer northward and eastward across the ocean. On the way, her captain expected

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to receive orders for unloading in Europe.

Unload—but where? Friday morning the possible ports were discussed. With her full cargo and deep draft, the Beauty was too big for any oil dock in Europe—except two. She could fit into Green Island on the Thames below London and into Fawley below Southampton. On the continent there was no place deep enough to take her.

The first job of the day for the deck crew was cleaning up. Despite drip buckets under the hose connections, oil had been spilled and the paint scraped off where the hoses had been dragged around. With sawdust, rags and swabs, the crew started what would become for them a familiar routine—mopping up the dangerous black ooze.

Another chore was to trim ship. When she'd gotten underway, she'd been down by the head. To get her stern deeper than her bow, oil was transferred by gravity from full tanks forward to partly filled ones aft.

Early Saturday, as daylight cracked the horizon, we sighted the lighthouse on Mona Island. By 0820, the last of the Caribbean islands were disappearing astern; the next landfall would be England. That night torrential rains fell. Never having had a ship equipped with radar before, the captain spent an hour tracking rain squalls on the 'scope.

Sunday was no day of rest. It started with emergency work. Black splotches of the inflammable cargo had been found on the main deck. Three leaks were discovered—the ship had been working mildly in the gradually increasing seas. Men hurried around cleaning up, while Poomps and the bosun sweated up the bolts on a leaking pipe flange.

Tuesday evening, the daily weather broadcast reported a low-pressure area with strong winds ahead. By Wednesday the sea was kicking up more. The ship slid down the face of quartering swells and splashed spray sky-high. Despite the white-capped swells, the deep-sitting Beauty never rolled more than six or seven degrees. But her working started two more oil leaks—luckily, small.

At dinner that night, the captain and a company observer discussed the unpopularity of giant tankers with seamen. The captain said he wouldn't be surprised if some of the crew wanted off at the first port.

On Thursday came two more reminders of the peril of oil at sea. First, the captain noticed that the insulation on the floodlight wires on the bridge was worn through. The same type of light was also mounted next to the tank vents aloft. Worn insulation *there*, the captain observed, would be more dangerous than smoking on the main deck, or dropping dynamite. A hasty check showed that the rigging wires were undamaged.

PLIMSOLL MARKS are checked by Capt. Masuch and British official on arrival at Fawley, England. If ship is overloaded, captain risks a heavy fine.

A second alarm came that night when thick fog closed in. Suddenly the radar showed a target dead ahead. The captain changed course to pass it half a mile abeam. We heard its whistle, but we never saw its lights.

Thursday was also the day the ship learned definitely that Fawley, England, was to be her unloading port.

Friday, a week out of Amuay, Meseck inspected the cofferdams, three-foot safety compartments extending the breadth and depth of the ship and separating the tanks from the rest of the hull. They are supposed to be empty. They were. He also inspected the Butterworth machines, complicated nozzles that spin streams of water around to clean tanks. Operated at 150-pound pressure with nearly boiling water, they knock residue and scale off the tank plates—but they're as tricky to handle as a boa constrictor.

Poomps and his assistant made the rounds of the tanks, taking cargo temperatures with thermometers on long strings. (The cargo was supposed to be kept

[Continued on page 216]

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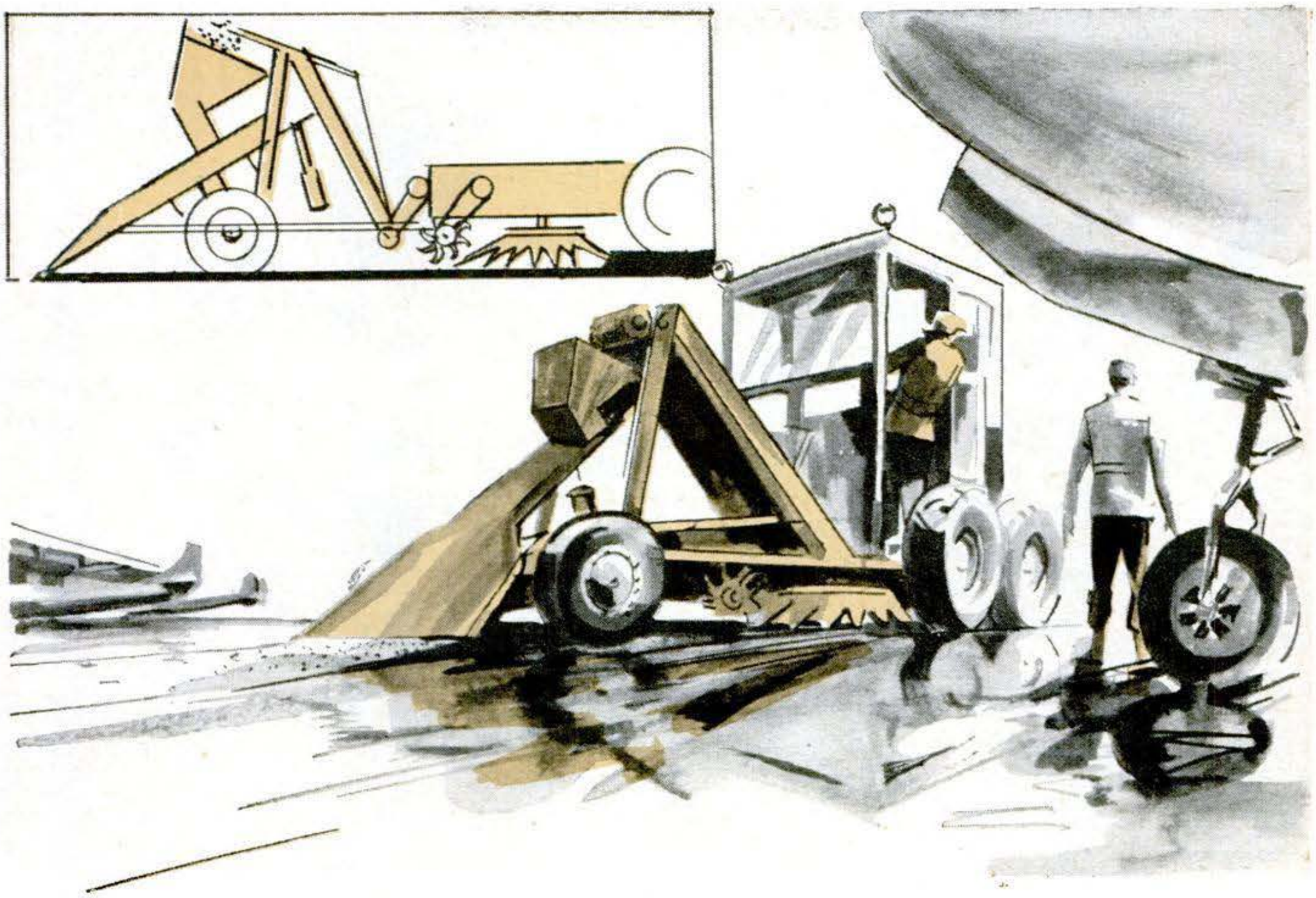
New Ideas from the Inventors



1 Chipped Ice Chips Ice. To remove the hard, slick film that remains after surface ice is scraped off a road or runway, this machine would use ice itself as an abrasive. Chunks plowed off the top would be pulverized, then sprayed over the thin but hard-frozen bottom layer through a high-velocity jet.

2 Magnets Hold Extra Lenses. Close-up lenses could be quickly added to regular glasses—and removed just as quickly—if the frames and lenses were fitted with magnetic inserts. Tiny pockets in the temples (also with magnetic holders) would store lenses between uses.

3 Brush Apron Catches Drips. A flared skirt around the ferrule of this brush would trap the paint that often drips down when bristles are pointed up. The handle—and your hand—would stay cleaner when you painted overhead, and drippings could be returned to the can.

Please turn the page for more new ideas

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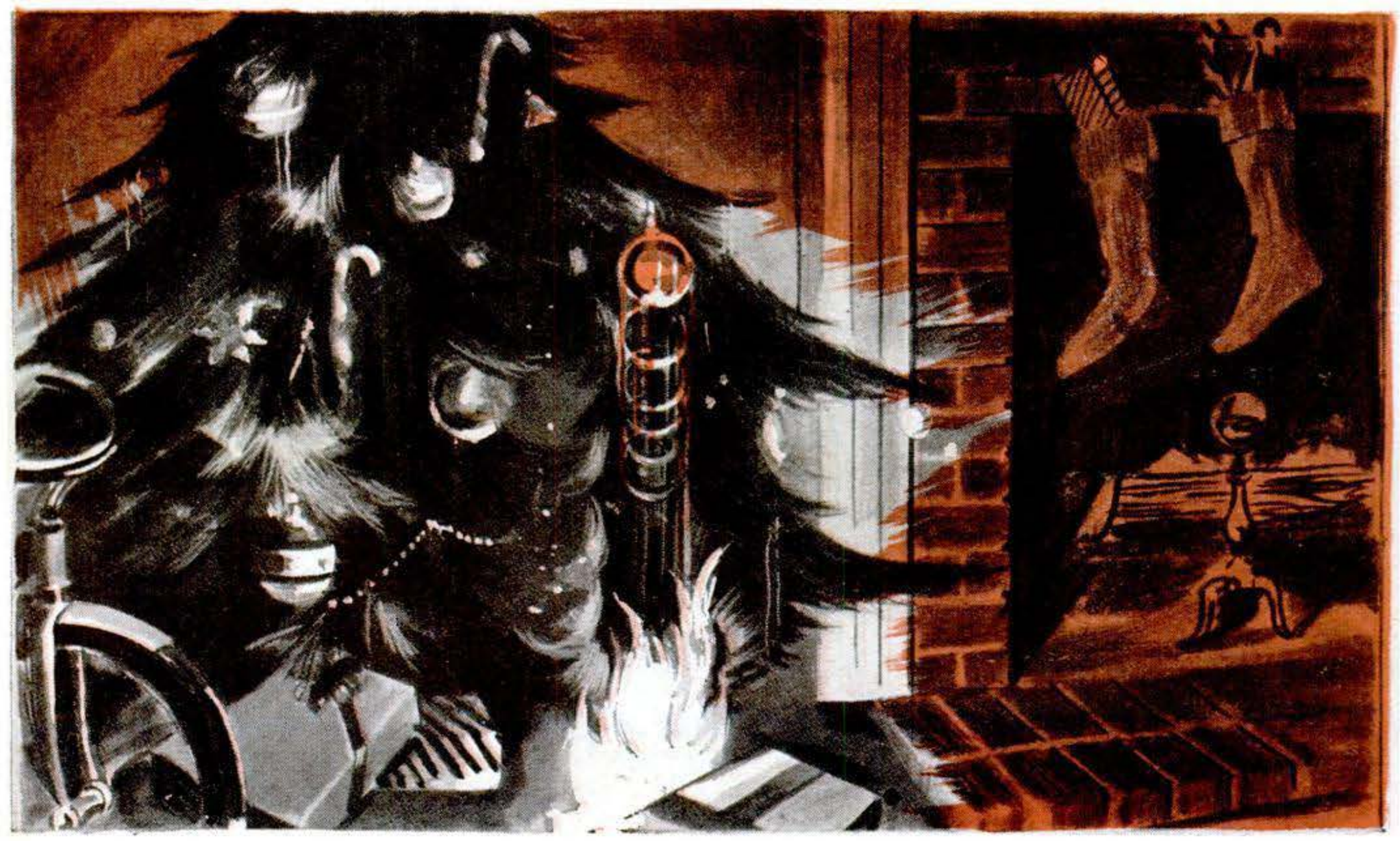
More Inventors' Ideas

4 Balloon Streamlines Truck. To gain extra speed or power on the open road, the driver of this truck could just inflate a streamlined tailpiece. The balloon wouldn't affect cargo space, and it could be quickly collapsed for easier maneuvering through towns or traffic.

5 Baby Slides on Rails. Instead of lifting Junior out of this folding carriage, using excess energy and maybe waking him, you'd just slide him out—and back in again—smoothly. Retaining rails would tilt to allow the bassinet to slide off at the most convenient angle.

6 Tree Decoration Fights Fire. Christmas-tree fires might take less of a toll if trees were trimmed with fire extinguishers. These glass balls, filled with flame-quenching liquid, would be suspended from fusible hooks. Heat would cause the fragile shells to drop—and to spatter their contents on a burning tree.



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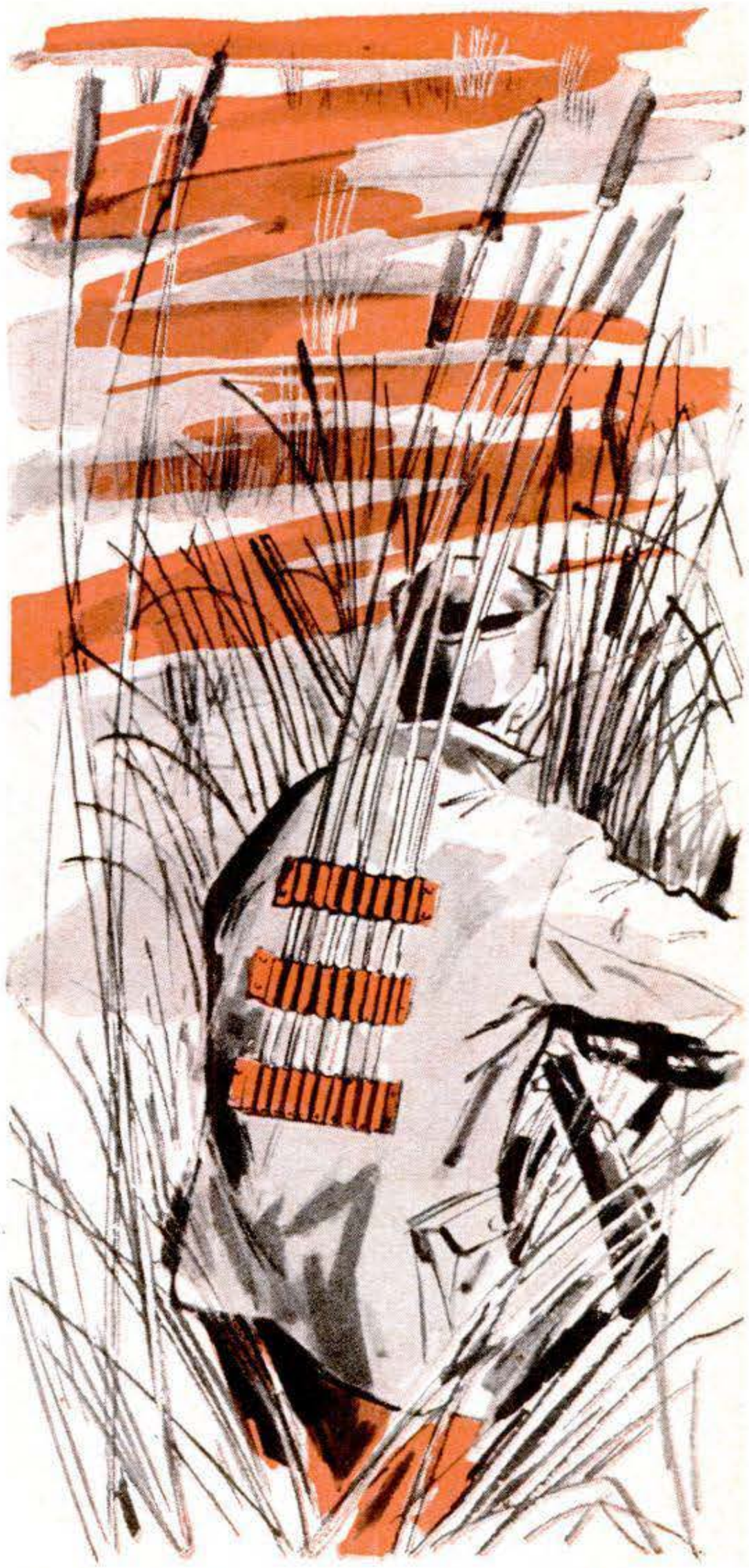
7 Hanger Clips on Chair. Your jacket wouldn't get bunched at the neck if you slipped it over a chair with a shoulder-draped back. Brackets attached to a conventional (or hookless) hanger would let you turn almost any chair into a convenient overnight clothing stand.

8 Trunk Light Flashes Warning. This blinker would flash a danger signal if you had to stop for roadside repairs. Hinged inside the raised trunk lid, the blinker would be clearly visible to oncoming cars. Swinging the light downward would disconnect the flasher and aim a steady beam into the trunk.



9 Jacket Camouflages Hunter. A waterfowl hunter who didn't find enough natural cover at the water's edge might bring along a plentiful extra supply if he had a jacket like the one shown here. Loops stitched to the front and back panels of the coat could hold long stalks of rushes or other concealing vegetation.

The following patents *have been issued on these inventions: 1. Patent No. 2,789,804 to H. A. Toulmin, Jr., Dayton, Ohio; 2. No. 2,737,847 to N. Tesauro, San Francisco; 3. No. 2,733,471 to J. I. Connor, Texarkana, Tex.; 4. No. 2,737,411 to R. B. Potter, Boulder, Colo.; 5. No. 2,733,928 to A. M. Boudreau, Gardner, Mass.; 6. No. 2,800,187 to R. Lehder, Stamford, Conn.; 7. No. 2,734,638, to A. Feldman, Woodside, N.Y.; 8. 2,736,005 to C. L. Craddock, N. Hollywood, Calif.; 9. No. 2,744,348 to G. F. Smith, Port Arthur, Tex.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

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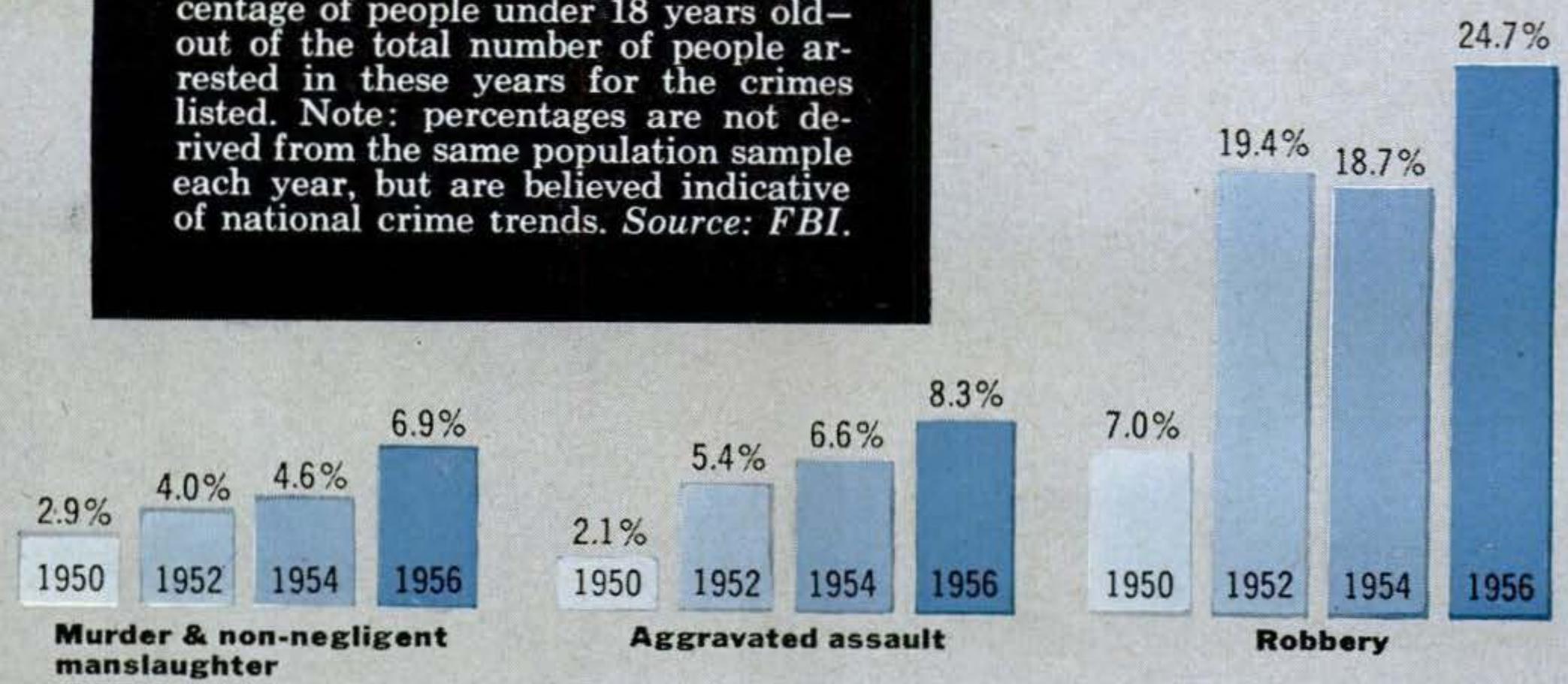
The Shocking Facts on Car Theft

How juvenile delinquency has grown

The accompanying chart shows the percentage of people under 18 years old—out of the total number of people arrested in these years for the crimes listed. Note: percentages are not derived from the same population sample each year, but are believed indicative of national crime trends. *Source: FBI.*



UNITED STATES DEPARTMENT OF JUSTICE
FEDERAL BUREAU OF INVESTIGATION

In Reply, Please Refer to File No.

WASHINGTON 25, D. C.

The theft of automobiles ranks as one of the most perplexing and widespread criminal problems facing the law enforcement agencies of the United States today. During the past five years, more than one million vehicles valued at over one billion dollars were stolen. This wholesale thievery means that during that period approximately two automobiles were stolen every five minutes.

I feel that "Popular Science" magazine is performing a much needed public service by printing this article which emphasizes the simple things which car owners can do to assist law enforcement in suppressing this tremendously costly crime against property.

J. Edgar Hoover

John Edgar Hoover
Director

How can you protect your car? Here's what one expert says: "Learn how car thieves operate—then take steps to make sure they don't operate on yours."

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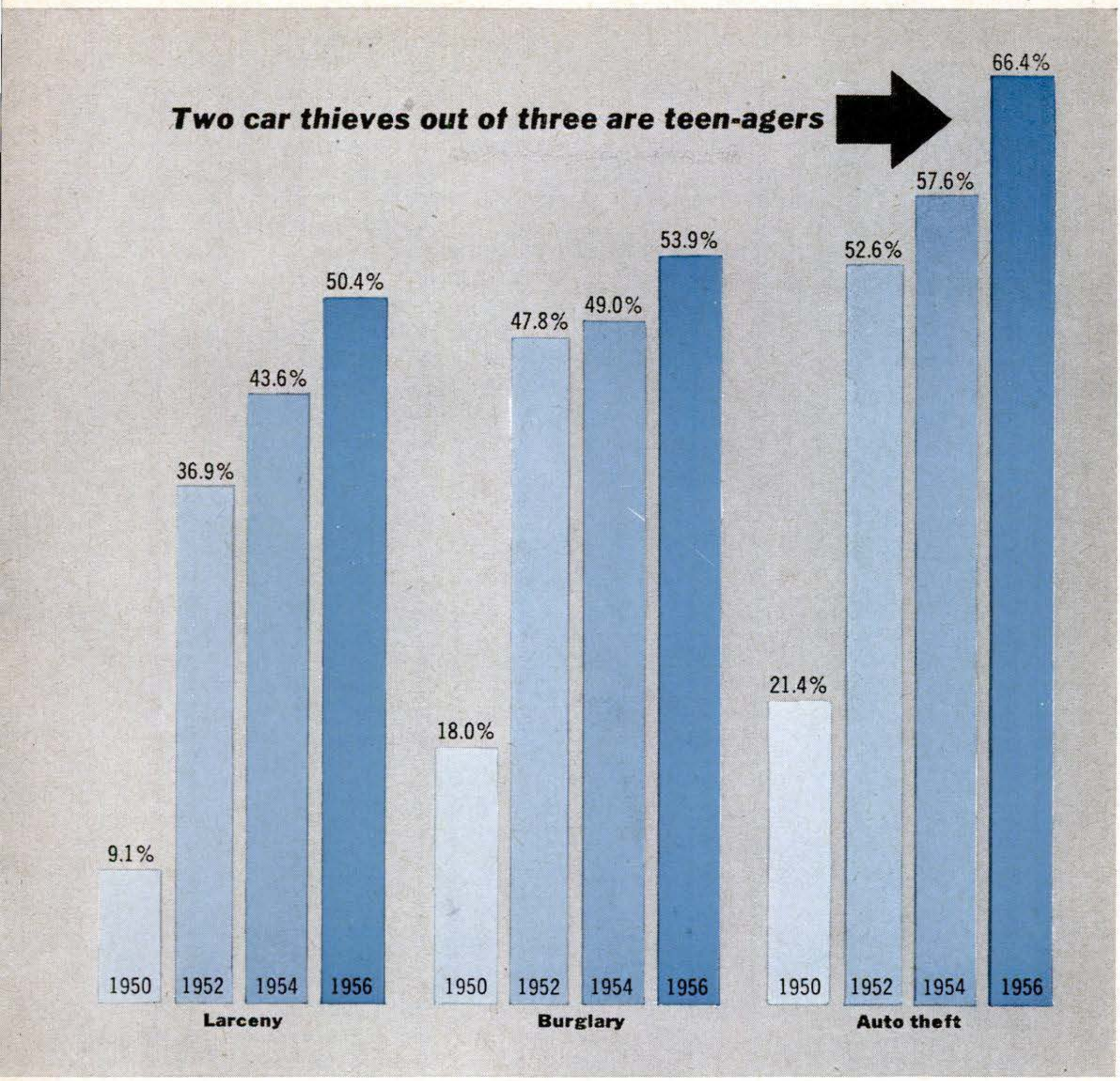

By Max Gunther

NATIONAL car-theft totals are climbing to staggering new records. According to the FBI, a record 263,720 motor vehicles were stolen in the U. S. last year—230 million dollars' worth. This was a 16.1-percent rise over 1955's figure of 227,150. All indications point to still more auto thefts in 1957.

Almost all kinds of crime increased last year. But auto theft led the field by a mile. No other type of crime increased by half that much. Thefts of auto accessories—tires, fog lights, radios, hubcaps—showed an even more shocking rise. In a study of this crime in 436 cities, the FBI reported a jump of more than 41 percent from 1955 to 1956.

In part, these increases are a result of growing population and car-ownership—but only in part. By far the biggest reason is juvenile delinquency.

Never before have so many teen-age auto thieves been on the prowl. All kinds of juvenile delinquency have increased alarmingly in the past two years; but no crime has attracted a bigger percentage of youngsters than auto theft. Of all people arrested for car-stealing last year, the Federal Bureau of Investigation reports, two-thirds were less than 18 years old.

For a picture of what's going on,

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glance at the record in Cincinnati. Of 146 people arrested in that city for car-stealing back in 1948, roughly a fifth were juveniles under 18. Of 265 arrested for the crime last year, more than three-fifths were juveniles. There were actually *fewer* adults in Cincinnati's car-theft picture last year than in 1948—yet the number of thefts almost doubled.

"Auto theft in Cincinnati today," says Police Chief Stanley R. Schrotel, "is primarily a youth crime." St. Louis police records show that 91 percent of all those arrested for car-stealing in the city last year were 16 or younger.

Why are so many kids stealing cars? "It sounds funny to put it this way," says a New York police official, "but it's all you can say: They're stealing cars for the sheer hell of it."

The FBI agrees. Car thefts are divided into three main categories: A car may be stolen (1) for sale, (2) for use in committing another crime, or (3) for fun. This last category—joyriding—has become by far the most common kind of auto theft. In a survey of 125 cities, the FBI found that 59.3 percent of car thefts last year were joyrides.

"Almost invariably," says an FBI officer, "a joyride begins with a bunch of youngsters hanging around with nothing to do, looking for a thrill." Sometimes the whole group will steal a car, ride around in it for a night and abandon it. At other times, the car will be stolen by one or two members of the gang on a dare or bet. The car is abandoned eventually—often badly damaged.

To a lesser extent, youngsters also steal cars and accessories for sale. In some parts of the country organized car-theft rings pay boys to bring in cars. There are used-car and junk dealers in most cities who will buy stolen cars and accessories—paying low prices but asking no questions.

Happily for car owners, a high percentage of stolen cars—93 percent last year—are recovered. Even so, the man whose car is lifted faces plenty of trouble. If your car is stolen, you may be without it for months. When you get it back damaged or wrecked, you may find that your insurance policy doesn't cover you. If joyriders have damaged someone else's car with yours, you may not be covered for your liability, either.

How can you protect your car? One basic piece of advice is offered by Sergeant William Fyffe, former auto-theft expert of the New York police and now consultant to Babaco Alarm Systems, Inc. Says Fyffe: "Know your enemy. Learn how thieves operate, then take steps to make sure they don't operate on your car."

The favorite hunting ground of thieves—pros and joyriders alike—is a dark street. So don't park on a street any more than you have to, and when you do, park near a street lamp or stores. Lock both ignition and doors. A locked car isn't an insuperable barrier to a thief, but an open car is an invitation.

If your car is more than eight or 10 years old, or if it's a conspicuous vehicle—such as a rare sports car—it isn't as prone to theft as newer or more common autos. But if it falls in neither category, the season on it is open. Police say that joyriders are likely to take the first car they come across that looks easy to steal—one with its doors open, or one parked where it can be worked on easily.

"A thief's first problem," says Sergeant Fyffe, "is to get inside your car." No matter how easy it is for him to lift the hood and jump the ignition, he's licked if he can't then get behind the wheel to drive away.

If you have a convertible, the thief can make a small, inconspicuous slit in the canvas top and lower a hooked wire or rod through it to grab the inside door handle. He's as good as in your car if you have the common type of lock that releases automatically when you move the

Where is your car safest?

Autos stolen in Los Angeles, 1956:
Stolen from:

Alleys	81
Parking lots	2,173
Driveways	270
Private garages	221
Public garages	56
Service-station lots	257
Streets	6,368
Used-car lots	497
Vacant or private lots	419
TOTAL	10,342

Source: Los Angeles Police Dept.

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How cars are stolen *Autos stolen in Cincinnati, 1956*

Stolen from: / Method of theft	Motor left running	Ignition locked, doors unlocked	Key left in ignition	Car broken into	Duplicate or skeleton key	Other	Total
Streets & highways	**8**	**192**	**232**	**145**	**1**	**41**	**619**
Residences	**0**	**9**	**21**	**3**	**0**	**5**	**38**
Commercial parking lots	**1**	**20**	**48**	**24**	**0**	**3**	**96**
All cars stolen in city*	**9**	**261**	**388**	**207**	**1**	**72**	**938**

**Note: Bottom row does not represent totals of columns, since cars are stolen from other places than the ones mentioned here.* *Source: Cincinnati Police Division*

inside handle. Police advise convertible owners to make the kind of lock modification sometimes used to keep kids from falling out—a latch that can only be released by pulling up the lock button.

A clever thief can still lift the button from outside the car, but joyriders generally won't go to that much trouble. A further protection is to take the buttons off. The slim shafts remaining are virtually impossible for a thief to manipulate from outside, but you can still work them with your fingers.

A thief can get into a sedan fairly easily, too. If your outside door handles are of the pivot rather than thumb-button type, and if they're the kind that stay rigid when locked instead of disengaging from the latch mechanism and turning loosely, watch out. A thief could force one of them open by wrenching it sharply with a length of pipe.

"Probably the favorite point of entry into a locked car," says an FBI official, "is the vent window." A thief may wedge the window barely open with a screwdriver, then push a bent piece of coat-hanger wire through the slit to release the vent catch. If he's foiled by a lock on the catch, or if the vent is the kind that has to be cranked open instead of merely pushed, the thief may use force instead of finesse. Using a screwdriver or a beer-can opener, he'll lever the vent open until the catch snaps off or the crank mechanism gives.

One way to beat thieves at the vent-window game is to drill a hole in the window frame just inside the forward, or inward-opening, edge of each vent. Then, whenever you have cause to be especially worried about theft, drive a sheet-metal screw into the hole so that the screwhead is snug up against the vent's metal frame. This will help the catch hold the vent closed. Faced with this, the thief may simply smash the vent glass—but on the other hand, he may simply walk away. A car with a broken-out vent is likely to arouse suspicion.

The thief's next problem, once in your car, is to close the ignition circuit. He may do this under the instrument panel or under the hood. If you have the older type of ignition switch with an armored cable, he'll probably have to work under the hood—but police say this is no problem if he knows his automotive wiring. If he's fast, he'll be driving your car off in a few minutes.

NEXT MONTH: Why is your son four times as likely to get into trouble as your daughter? Read: "Why Girls Are So Good" in January PS.

You can foil him by installing an extra ignition switch in some secret place. Police authorities think the best idea might be for Detroit to develop a switch that not only breaks the electrical circuit but also mechanically locks some vital engine part such as the distributor rotor. They also suggest a hand-brake lock.

What can you do to protect your outside-the-car accessories—tires, spotlight, hubcaps? Almost nothing (except in the case of some bolt-on accessories; you can file away screw slots and burr bolt threads). The worst hours for car and accessory theft are those between dusk and midnight. In this period, if possible, get your car off the street. END

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How Good Are the Shops in Your Youngster's School?

Your youngster can learn a trade in high school—if he gets the right kind of vocational training. Here's how to check

By Erik H. Arctander

THE United States now has 8,200,000 skilled craftsmen. By 1965 we'll need 10,200,000.

You don't have to study statistics to get the idea. Help-wanted ads reveal the demand for all kinds of craftsmen: machinists, appliance repairmen, sheet-metal workers, tool-and-die makers, auto mechanics.

These jobs are among the finest your son can aspire to. They are steady, secure, challenging. The pay is excellent. It has risen sharply since World War II to approach that of college-trained professionals. It will increase still more.

There's a catch, though. Jobs like these require training—lots of it. Your boy should be able to get some of this skill-education in high school. Can he?

To find out what schools are doing to help likely youngsters get started as skilled craftsmen I questioned leading officials in education, government, business and unions. Then, to see for myself, I visited some of the outstanding school shops in the country.

What I found was not one system of school shops but two:

Industrial-arts shops are provided by ordinary high schools for all boys, whether they plan to become machinists, lawyers or poets. They introduce the youth of America to the tools and machines that keep America running. They may steer some boys toward careers in the skilled crafts. But they are *not* intended as training for those careers.

Vocational-training shops are specialized. Each one is part of a separate educational program. They *do* teach youngsters a trade—auto repair, aircraft maintenance, sheet-metal work. They prepare students to take on adult work, not necessarily as fully qualified journeymen, but with more-than-rudimentary competence.

What's a vocational high school like? I visited one of the finest in the country, a $10,000,000 layout occupying two city blocks in Milwaukee. I saw bright, spacious shops, each with its classroom.

Here, future auto mechanics study in a real service garage with big roll-up doors, a car-size elevator, exhaust hoses built into the floor.

Metallurgy students have heat-treating furnaces, strength-testing machines, even a complete X-ray lab. For boys studying other trades there are diesel engines, welding booths, a patternmaking shop, a small foundry, even a complete television station (WMVS-TV, channel 10).

The Milwaukee school is completely independent, with its own buildings, budget and school board.

In small cities, the vocational high school is often in the same building as the general high school. Besides city vocational high schools there are also "area" schools run by state or county governments, or by groups of municipalities working together.

Whatever the setup, vocational high

PHOTO BY ROBERT D. BORST

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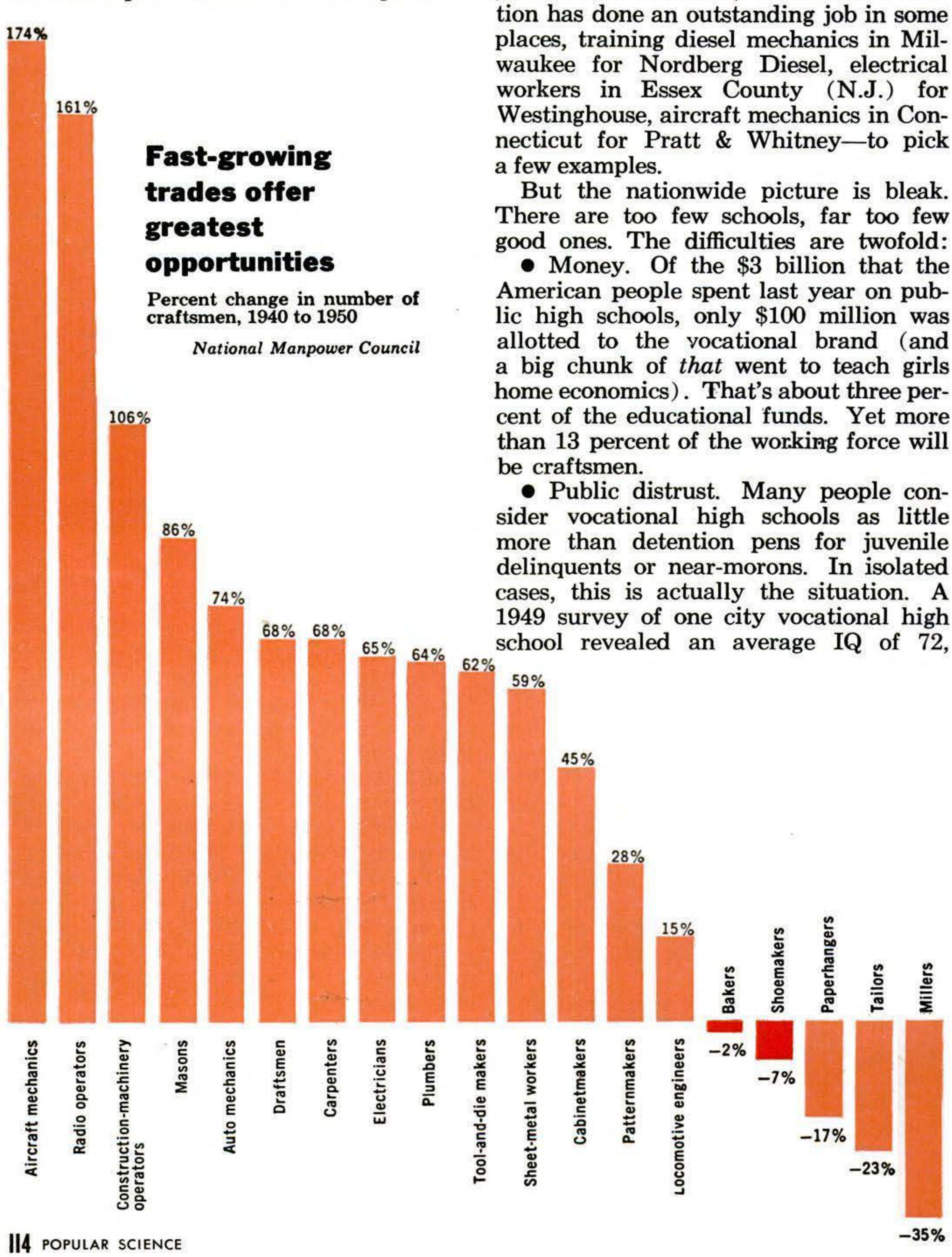
schools are quite different from the more familiar general type:

- They cost more to equip and operate. The cost per student is 20 percent greater, as much as $700 a year.
- The school day is an hour longer. Students spend one-half to three-quarters of the time in shops, the rest in class.
- The teachers are different—they are drawn from industry and most are also trained in special vocational-teachers' colleges.

How good are they? In the 40-odd years of its existence, vocational education has done an outstanding job in some places, training diesel mechanics in Milwaukee for Nordberg Diesel, electrical workers in Essex County (N.J.) for Westinghouse, aircraft mechanics in Connecticut for Pratt & Whitney—to pick a few examples.

But the nationwide picture is bleak. There are too few schools, far too few good ones. The difficulties are twofold:

- Money. Of the $3 billion that the American people spent last year on public high schools, only $100 million was allotted to the vocational brand (and a big chunk of *that* went to teach girls home economics). That's about three percent of the educational funds. Yet more than 13 percent of the working force will be craftsmen.
- Public distrust. Many people consider vocational high schools as little more than detention pens for juvenile delinquents or near-morons. In isolated cases, this is actually the situation. A 1949 survey of one city vocational high school revealed an average IQ of 72,



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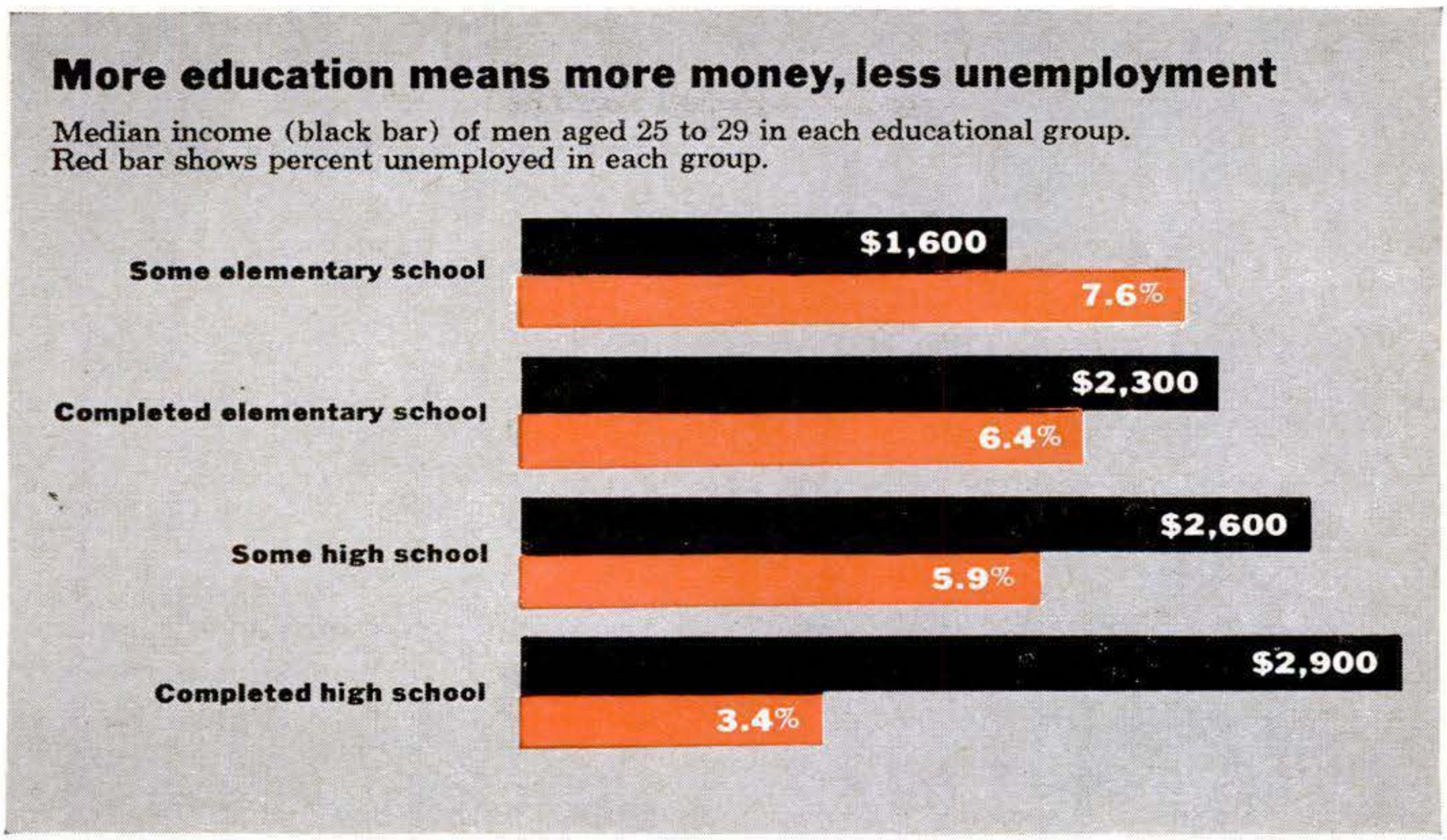
time—or lead to a skilled job at high pay



way below "normal." But a school like this is the rotten apple that spoils the barrel. The National Manpower Council surveyed vocational students around the country and found their average IQ to be about equal to the average for the general population.

"Parents who want their kids to enter a white-collar occupation are the main problem," Prof. Hamden L. Forkner of Teachers College, Columbia University, told me. "They think of vocational education as a kind of last resort; if a boy doesn't get along well in regular schoolwork he can at least succeed in a trade."

Is your boy a good prospect for a vocational high school? A couple of do's and don'ts will serve as guideposts.

Don't consider a vocational high school just because your boy can't master English and math. Vocational schools have no magic recipe for converting poor students into $200-a-week tool-and-die men.

Don't sign your boy up for vocational training if his talents and desires suit him to a college education. He can't get into college on the strength of most vocational diplomas.

Do investigate vocational training if your son enjoys working with his hands and is good at it. Most schools test students to measure these characteristics. If your local schools do not, you can get expert advice from an outside testing agency (see July PS: "How to Help Your Youngster Choose a Career").

Do urge your boy to enroll if the vocational program is up to date, practical and thorough.

Where to enroll? You're lucky if you have a good vocational high school nearby. Half of all vocational students are concentrated in only seven states. In six states—Connecticut, Louisiana, Georgia, Alabama, California and Kentucky—vocational training is available to all residents. The states themselves run the schools. Georgia, with only two state schools, provides dormitories for students whose homes are beyond the commuting distance. If you live in one of

[*Continued on page 224*]

Next Month: Can Your Son Learn a Trade in the Service?

The armed forces train thousands of young men—and women—in technical skills that are prized in civilian life. Can your youngster use this route to a good career? See January PS for the facts.

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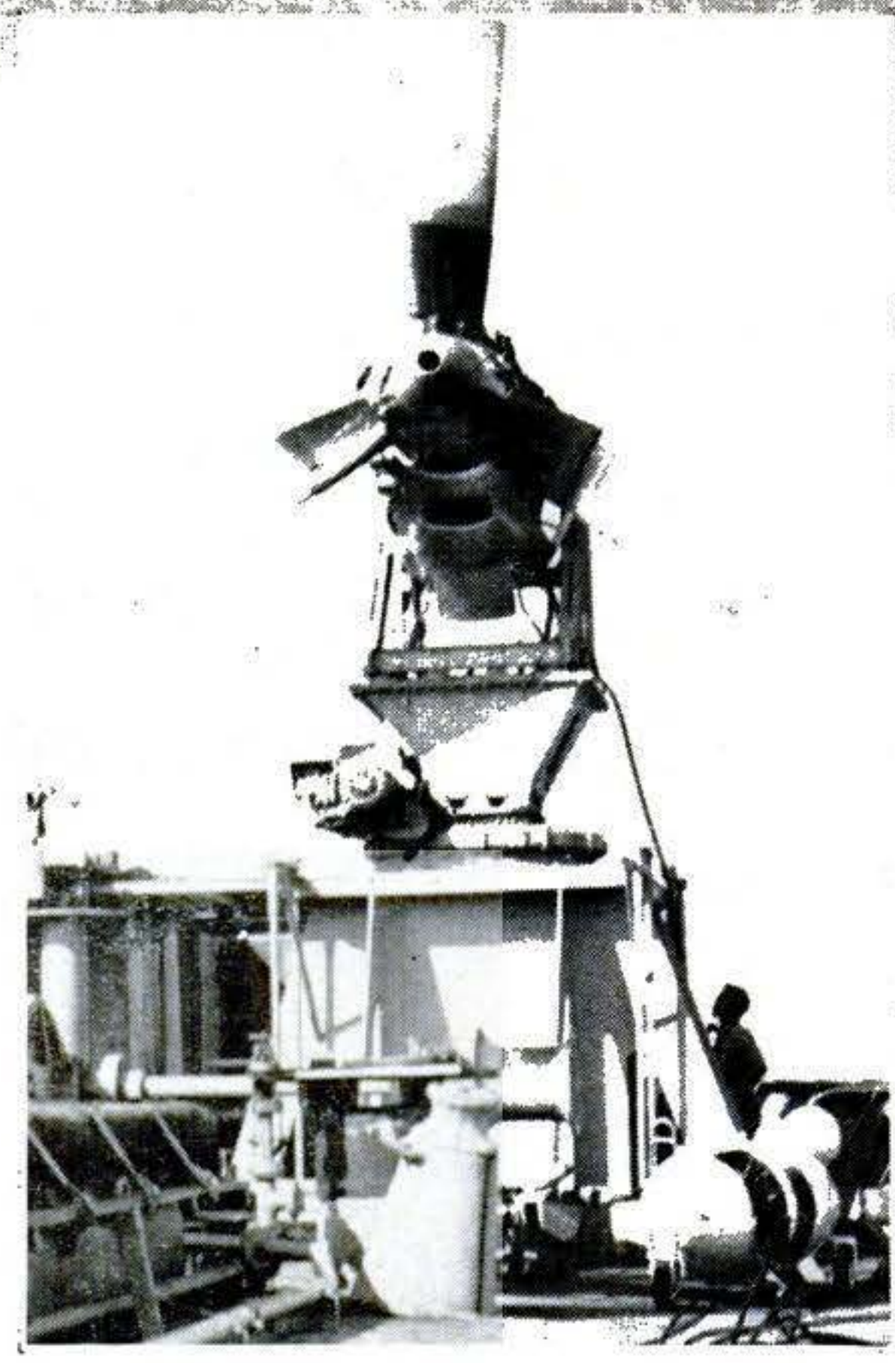

Aircraft turboprops on its deck power Liberty ship

FOUR turboprop engines totaling 24,000 hp. propel this converted Liberty ship in a Navy experiment. The regular propeller of the YAG-37 (former SS John L. Sullivan) was removed, the old engine shut down, and the plane motors—two on the foredeck and two aft—installed

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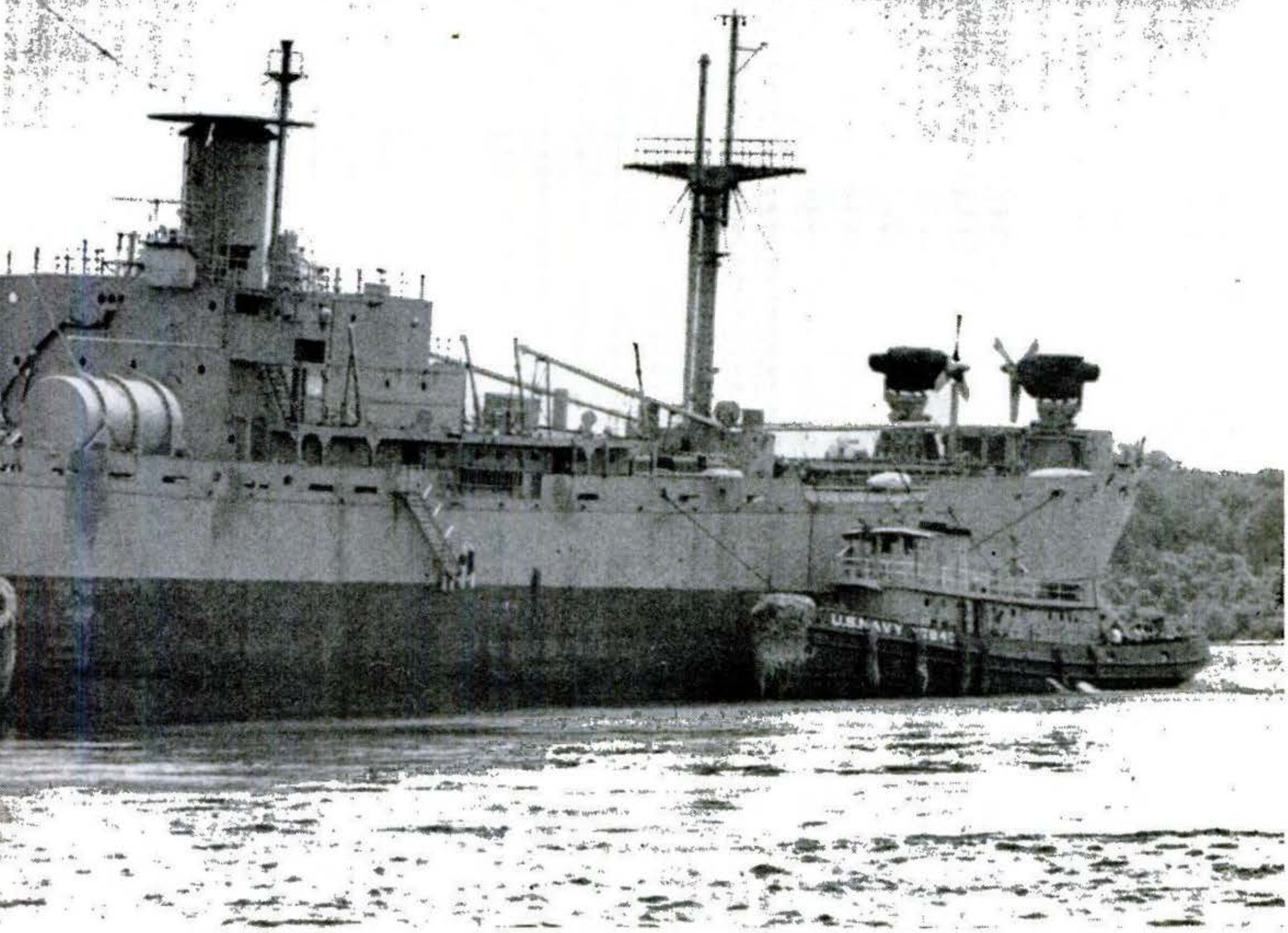

on 360-degree-swivel gun mounts. Controls for engines, rudder, ballast and fuel are in the wheelhouse. This is the first use of air-boat principles on a major ocean vessel. It moves propulsion from a vulnerable underwater area and halves the crew to 20. Here the YAG-37 is under tow from Rawls Brothers shipyard in Jacksonville, Fla., for Navy tests.

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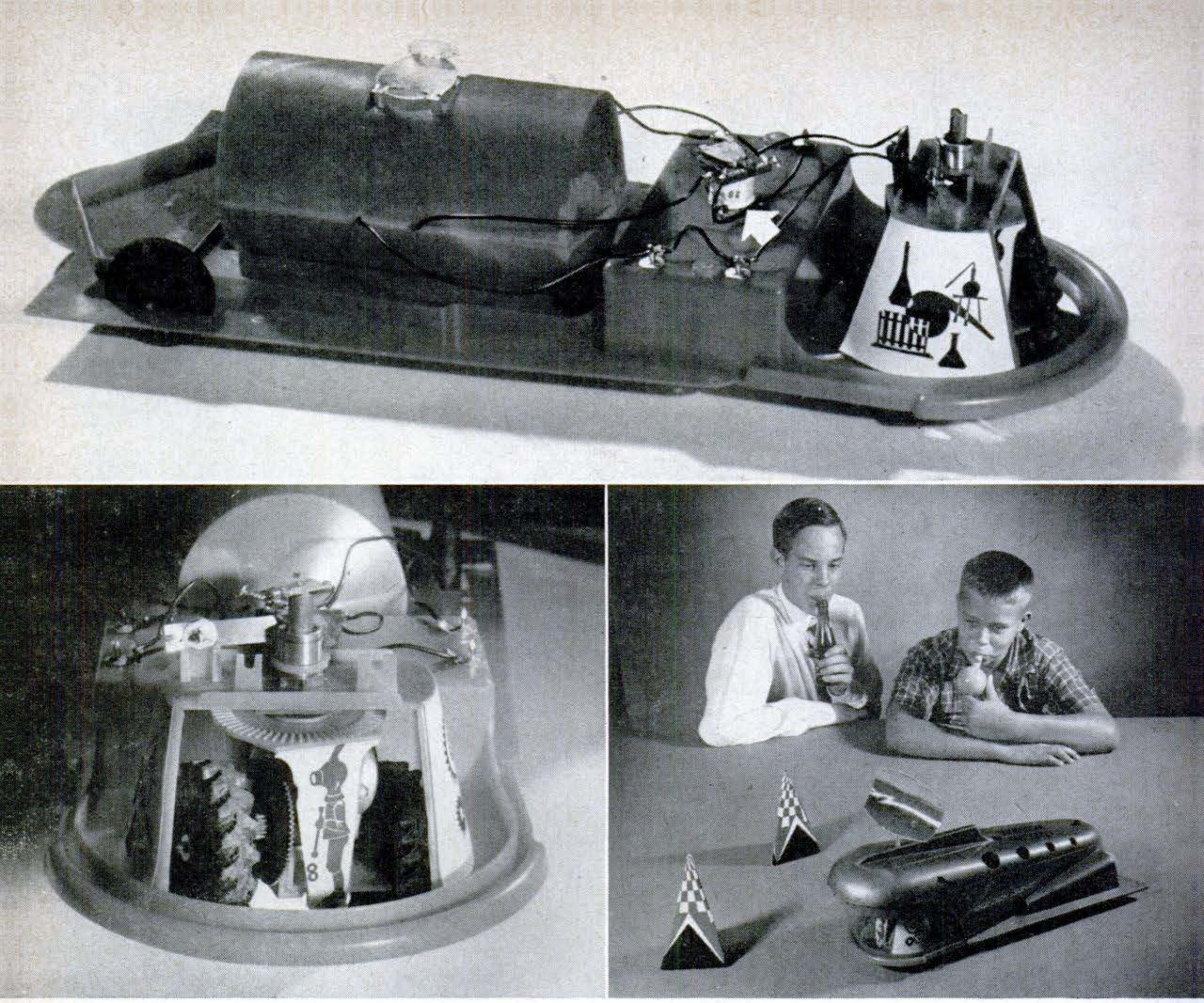
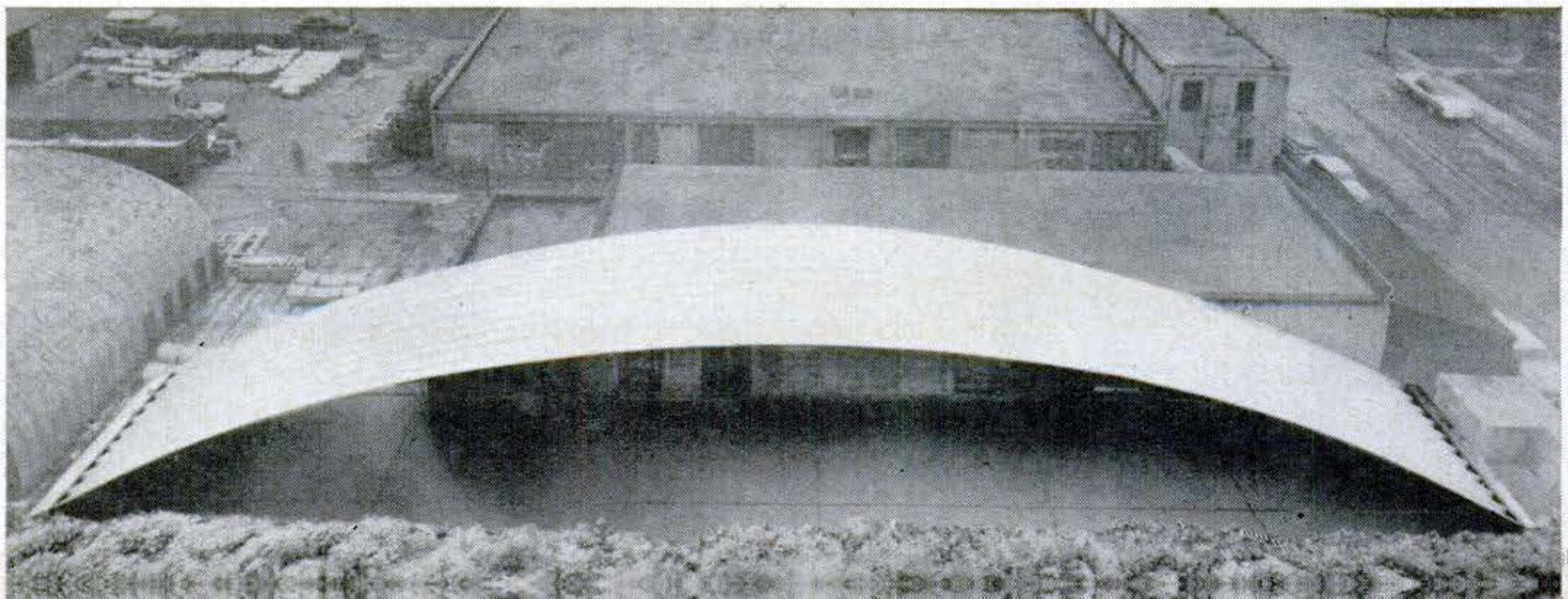


Sound waves steer toy car by remote control

A PLASTIC disk vibrating on top of a resonator (arrow, top photo) directs or reverses this car at the sound of a whistle. Blowing over a half-filled pop bottle also controls it. The vibrator dances on contact points in a flashlight-battery circuit to control the wheel assembly (left). Tigrett Industries, Jackson, Tenn., designed the sonic toy.

Widest self-supporting roof spans 150 feet

MADE of 10-foot steel panels bolted together, the full-size pilot roof below stretches 150 feet without need of pillars, trusses or other supports. Wonder Building Corp. of America calls it the widest clear-span roof in the world, prefabricates them for big arenas and aircraft hangars.



Pipeline bridge wins title of nation's most beautiful

TOP award winner this year in the annual beauty contest for new steel bridges is this one—carrying twin natural-gas pipelines across the Missouri at Plattsmouth, Neb. A jury selected by the American Institute of Steel Construction found it not only the most beautiful big bridge but "best in the show." It was praised for good taste and a simple solution.

Hinged license plate gives driver an automatic SOS

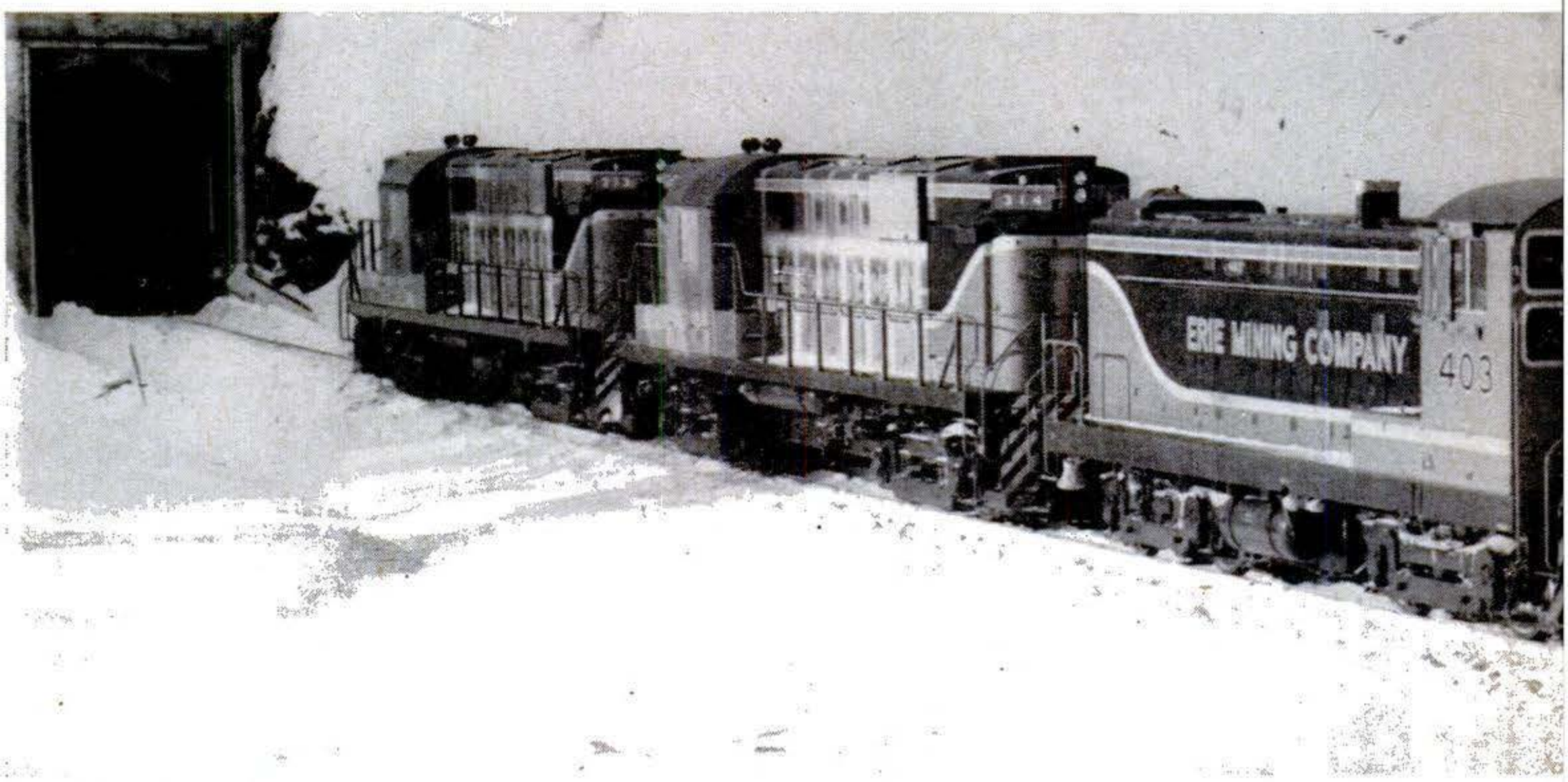
DISTURBED by reading of car holdups, Homer Grant of Independence, Mo., rigged up this call for help. A button near the floorboard dimmer switch triggers the mechanism without tipping off an unwelcome rider. It flips down the license plate and shows a distress message behind it.

308 underwater lamps illuminate airport fountain

A TOTAL of 916 fountain nozzles, plus 308 floodlamps, all under water, makes this spectacular display of a 200-foot, 350,000-gallon pool at New York's International Airport. The nozzles can spout 3,100 gallons a minute. The lights, housed in watertight aluminum, rate 118,000 watts.

Hibernating diesels get winter rest in long tunnel

WHEN Minnesota's deep snows set in, Erie Mining Co. finds protection for its diesel locomotives and their electrical instruments in an 1,800-foot tunnel on its line. Here the first section of a string of 27 heads



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Plastic bubbles atop Paris roof increase inside light

NEW skylights installed on the roof of this banking establishment in Paris are made of plastic in the form of big halved balls. The spherical design is said to collect more sunlight and to distribute it evenly inside for better daytime lighting for employees on the floor beneath.

for the tunnel entrance. Doors shut out the cold, but two of the diesels are started periodically to shift the others and prevent freezing of the bearings. The line hauls taconite 73 miles from plant to Lake Superior. The company hopes to shift eventually to year-'round operation.

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Army's Ranger travels sideways in surf, sand, snow

WITH rear wheels that cut as sharply as the front ones, this fork-lift moves forward, backward or to the side in deep snow or soft sand. Built for Army beach and rough-ground operations by Clark Equipment Co., the Ranger has airplane-type disk brakes that can work in five feet of water. Its hydraulic, telescoping fork acts as a jack to lift it out of holes.

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Air-buoyed suit keeps logger afloat

WHEN a boom man wearing this suit slips while catwalking from log to log, he is in no danger of drowning. Inside the special jacket and trousers, used by Weyerhaeuser Timber loggers in the far Northwest, are air-tube floats. They attach to the clothing with zippers.

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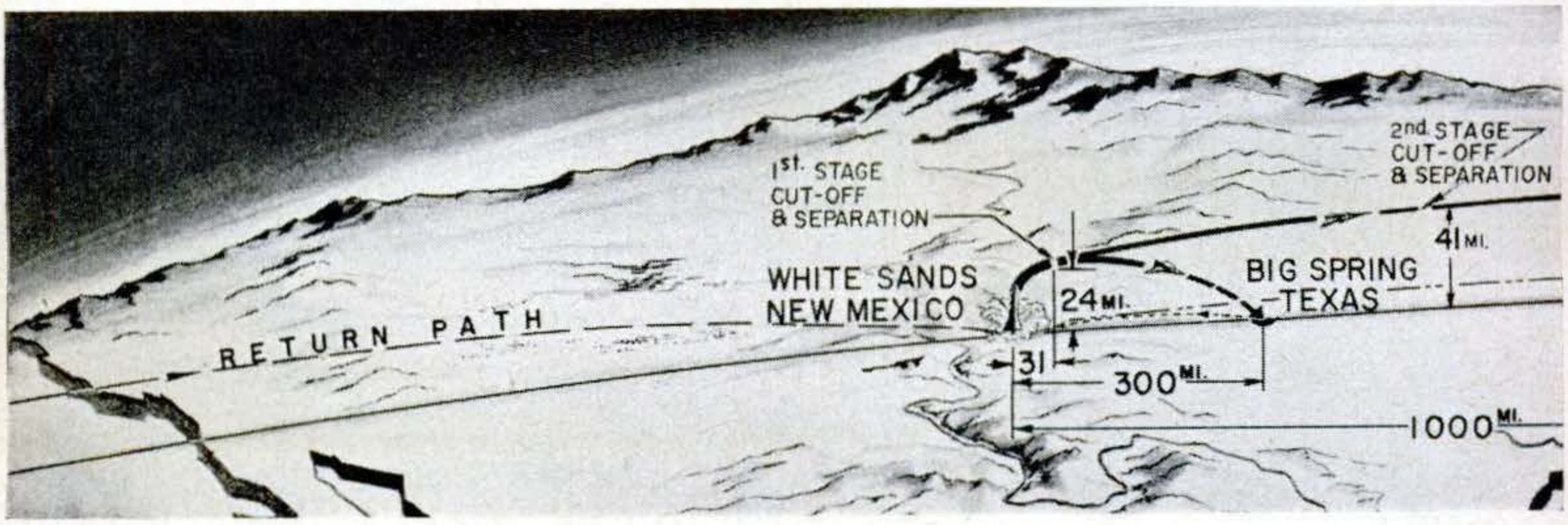
READY FOR LAUNCHING

Satellite with crew? By 1965, U. S. experts say

A THREE-STAGE rocket, its third stage to enter an earth orbit and return safely after two months, is proposed by Goodyear Aircraft scientists as a possibility within eight years. A modified version of an earlier design (PS, Apr. '55), Meteor Jr. would be 142 feet long, weigh 500 tons and consist of three delta-winged rockets, each with its own



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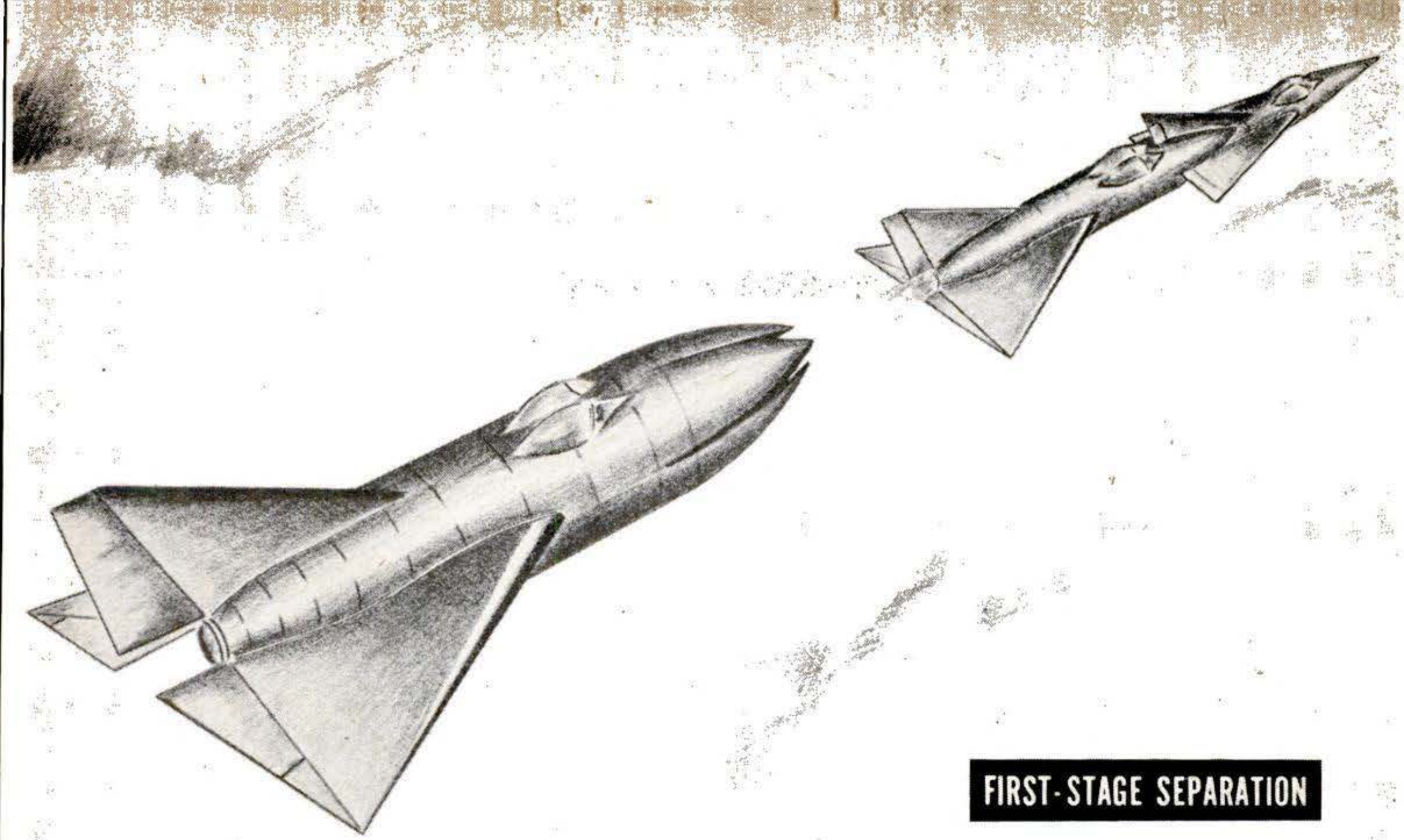
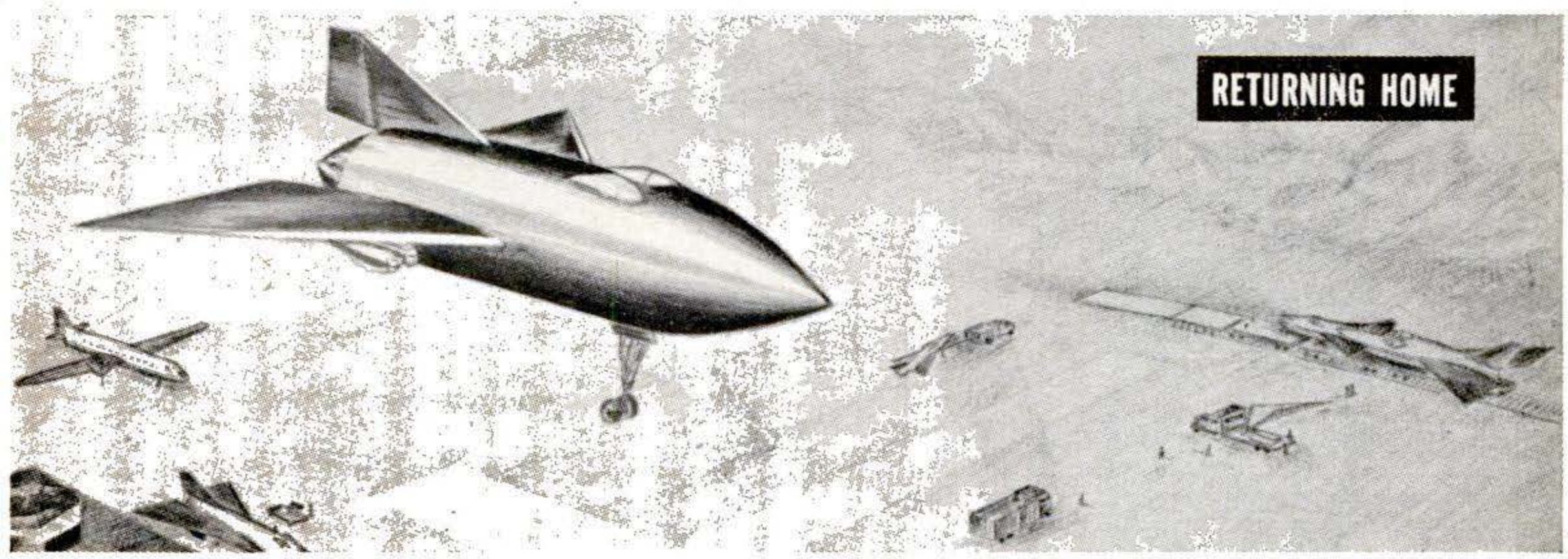
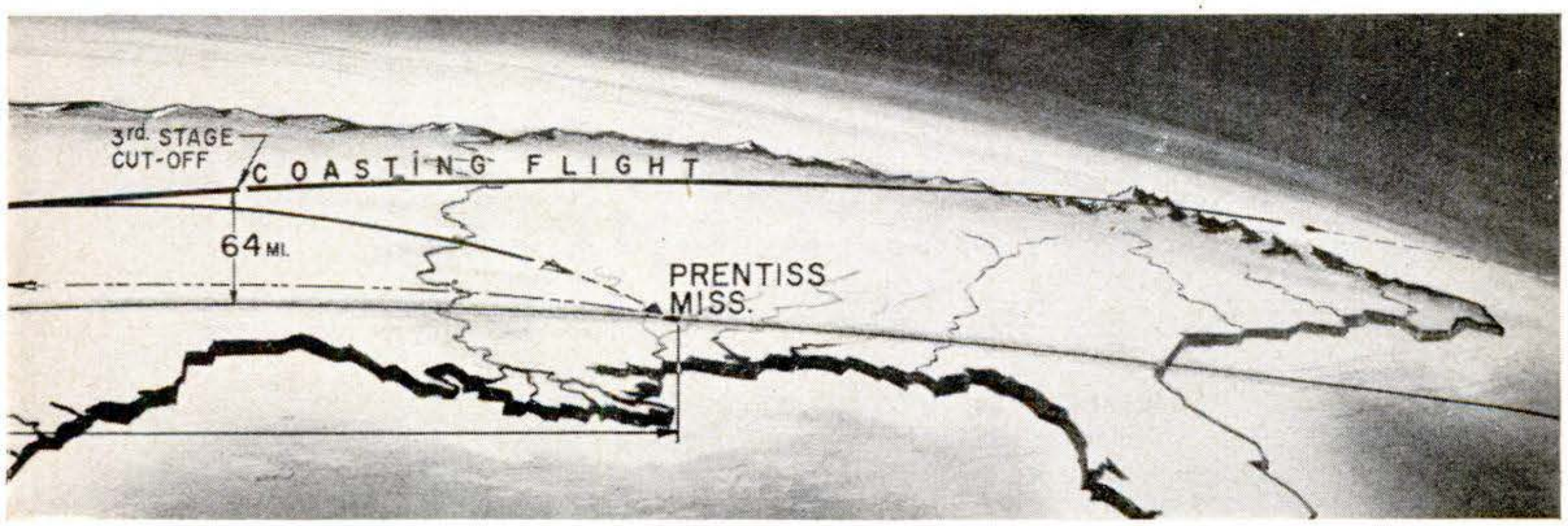




crew. It would be launched at White Sands. Its booster stage would drop 300 miles away—altitude, 24 miles—its second stage 700 miles farther, 41 miles up. The third stage, with crew of three, would circle the earth 500 miles up at 16,660 m.p.h., with supplies for two months and return fuel. Darrell C. Romick, head of the Goodyear group that designed it, compares its cost to that of the intercontinental B-52 bomber.



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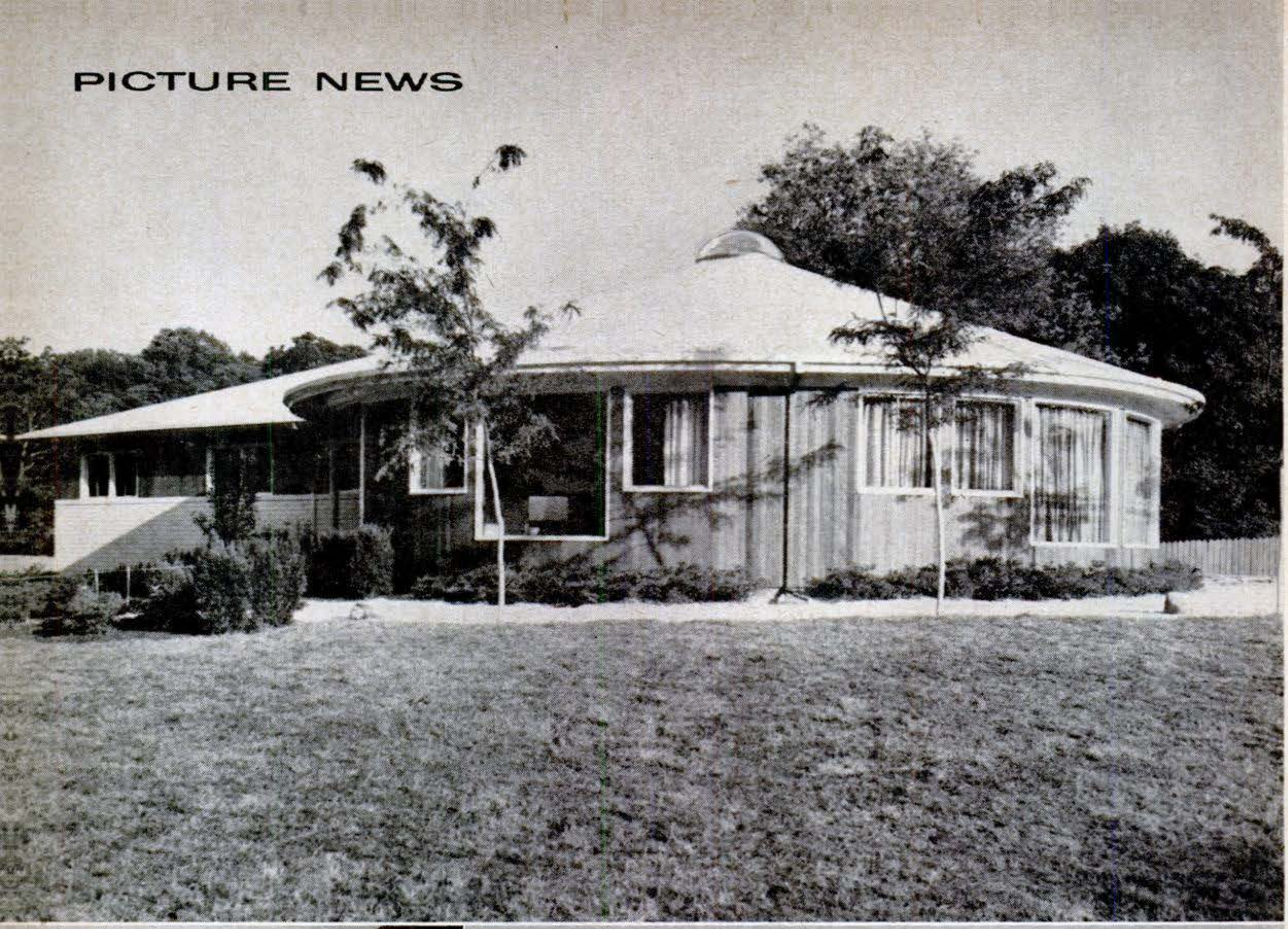

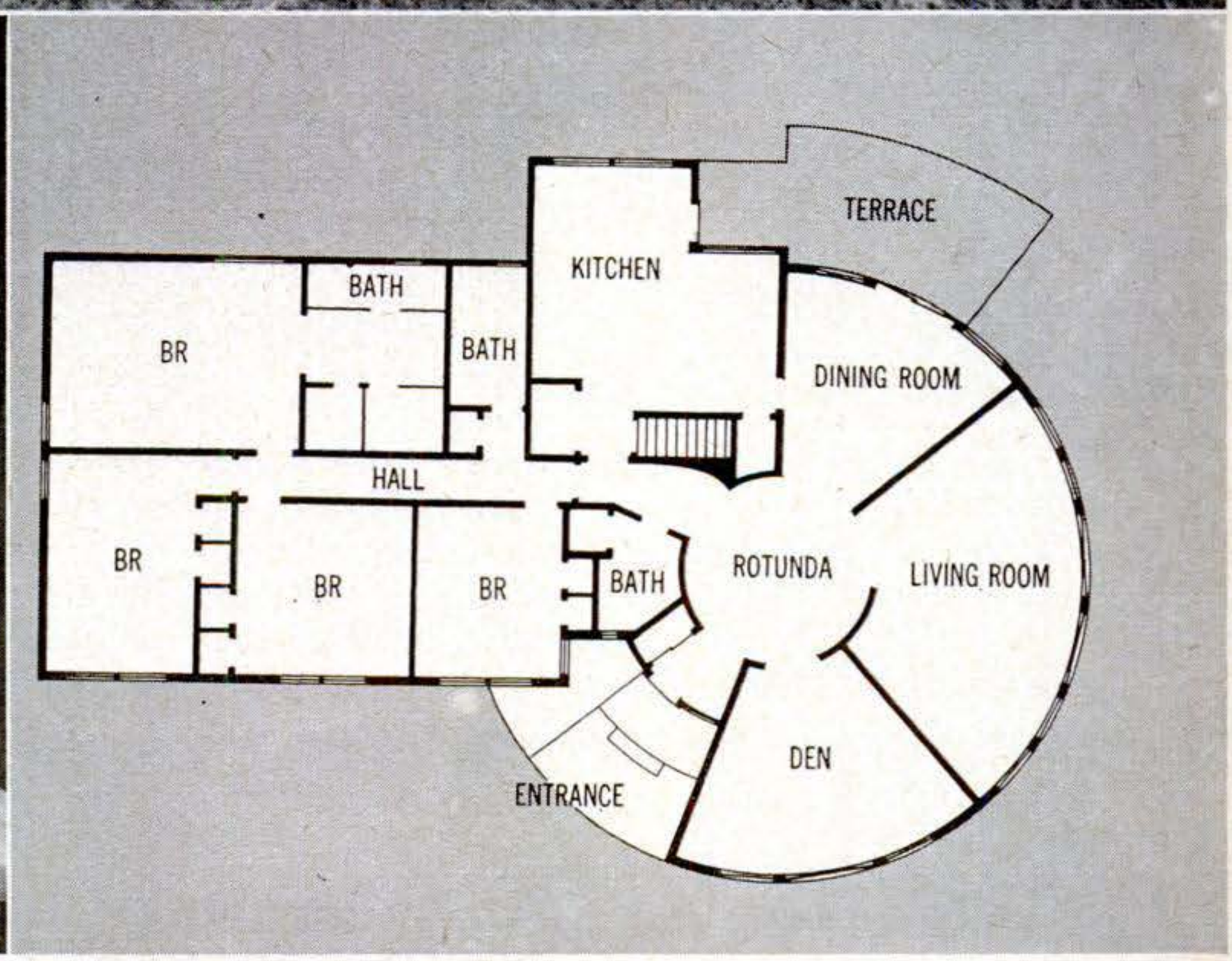

Circular house is sliced into wedge-shaped rooms

AN UNUSUAL architectural design produced this house, a model home in a development on New York's Long Island. The main section is circular, on a 21-foot radius, to enclose a wedge-shaped dining room, living room and den around a rotunda topped at the roof's apex with a transparent plastic dome. Bedrooms are in a rectangular wing. Architect Michael L. Radoslovich planned it for Country Estates, Roslyn Hills.

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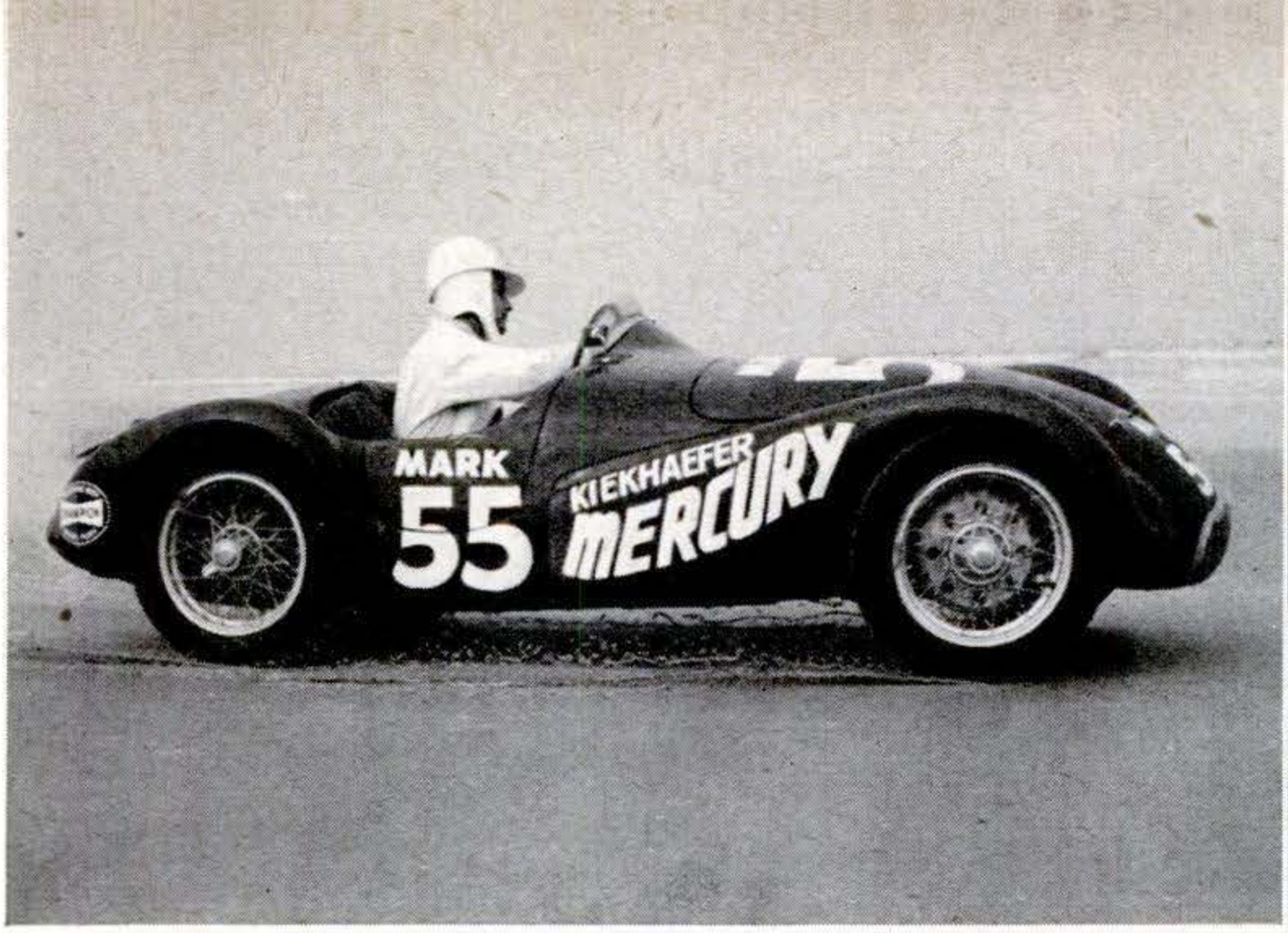
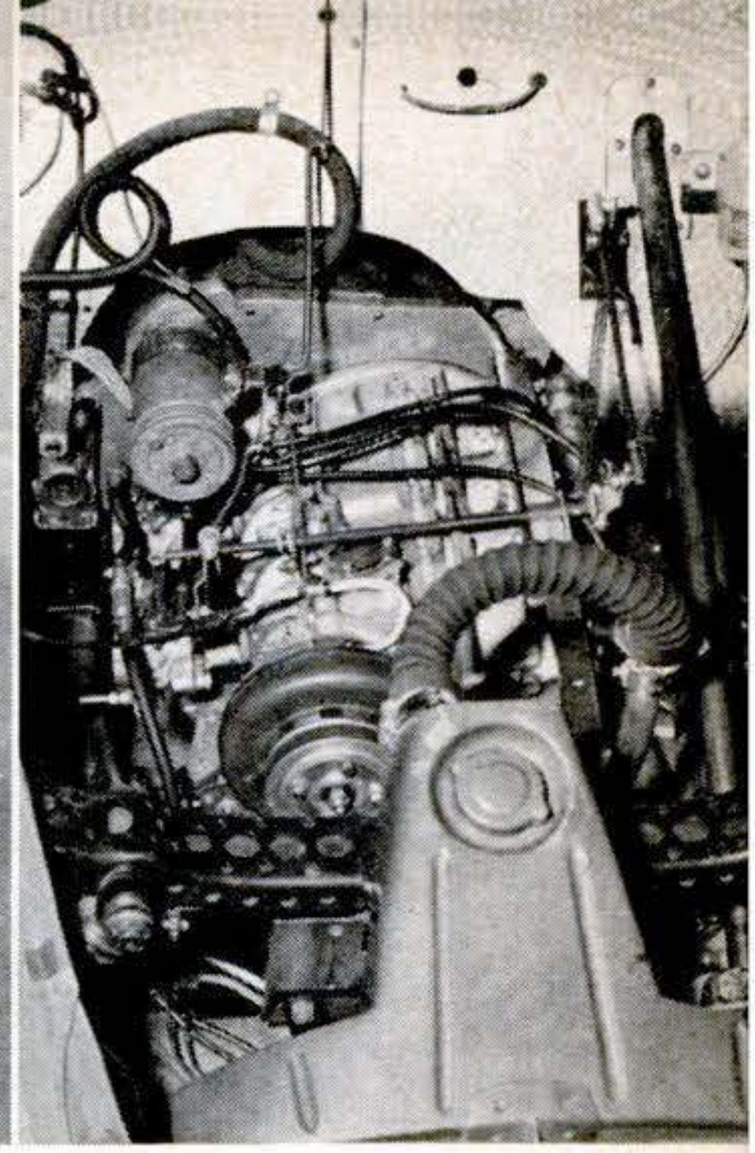


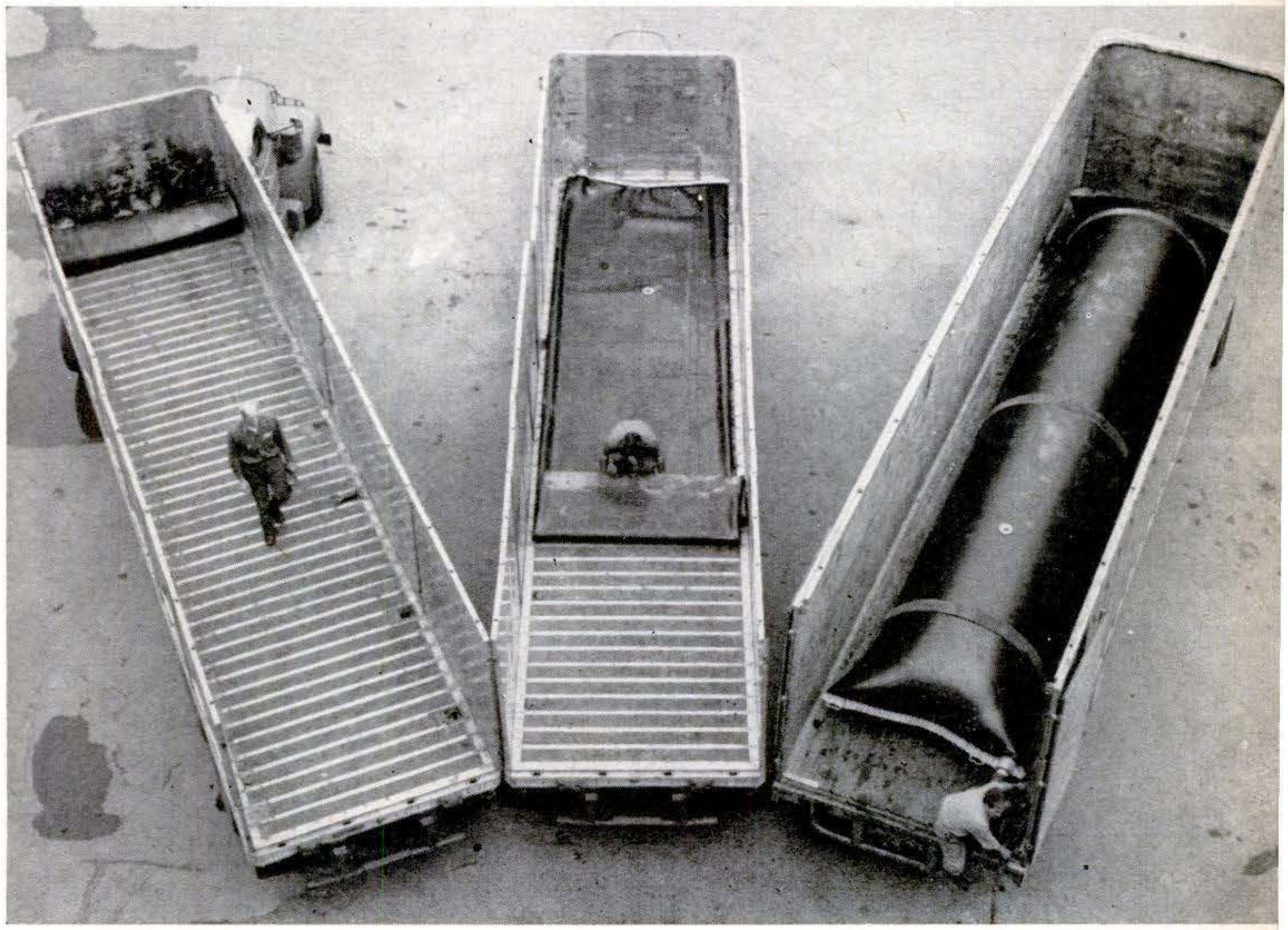


Outboard motor moves inboard to power racing car

A 40-HP. outboard replaces the regular engine of this lightweight sports car, which has exceeded 100 m.p.h. A four-cylinder Mercury was installed on its side (above right) with the crankshaft horizontal and the carburetors rotated 90 degrees. The exchange cut weight 110 pounds.

Rubber "toothpaste tube" converts truck to tank car

EQUIPPED with huge roll-up tubes, the trucks below can haul dry cargo one way and liquid the other. The tubes, made by U. S. Rubber of four-ply rubber-coated rayon tire fabric, are 55 inches in diameter, 35 feet long and hold 3,800 gallons. Bigger ones for rail cars and barges are planned.



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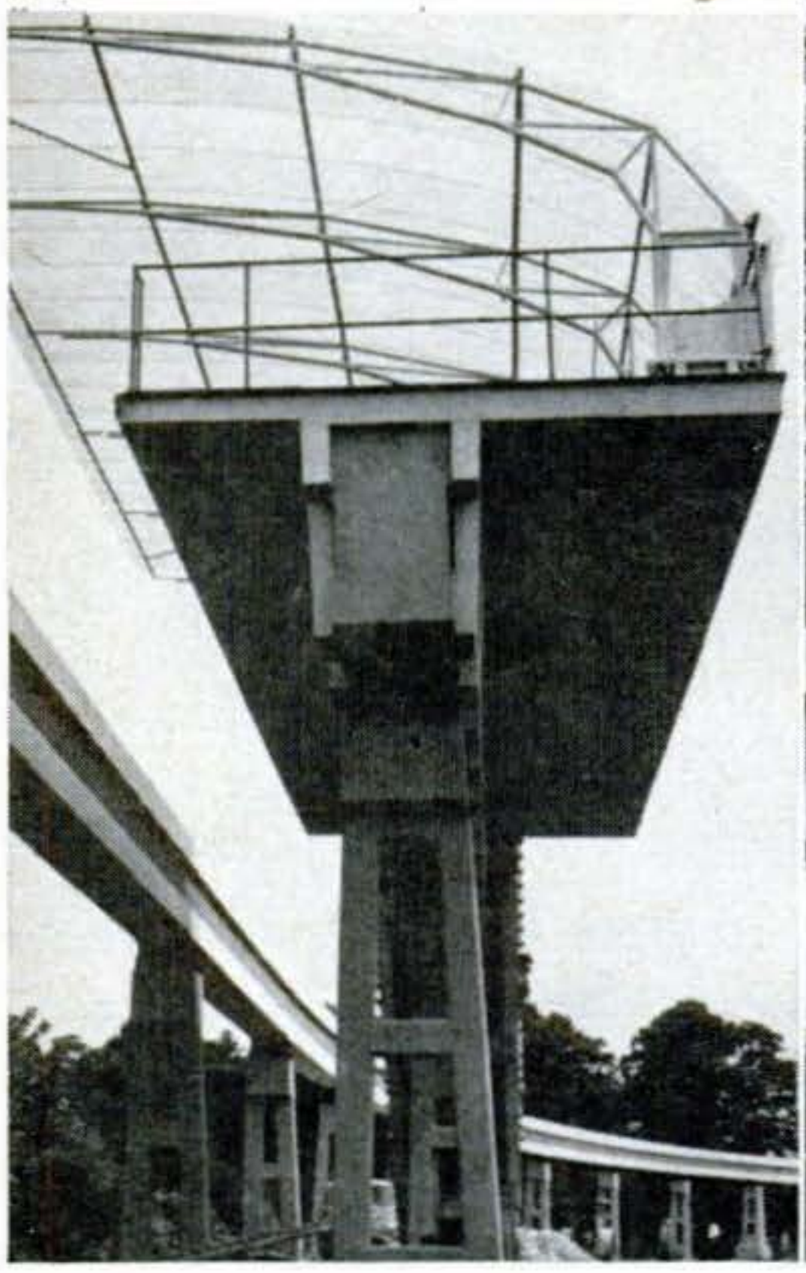

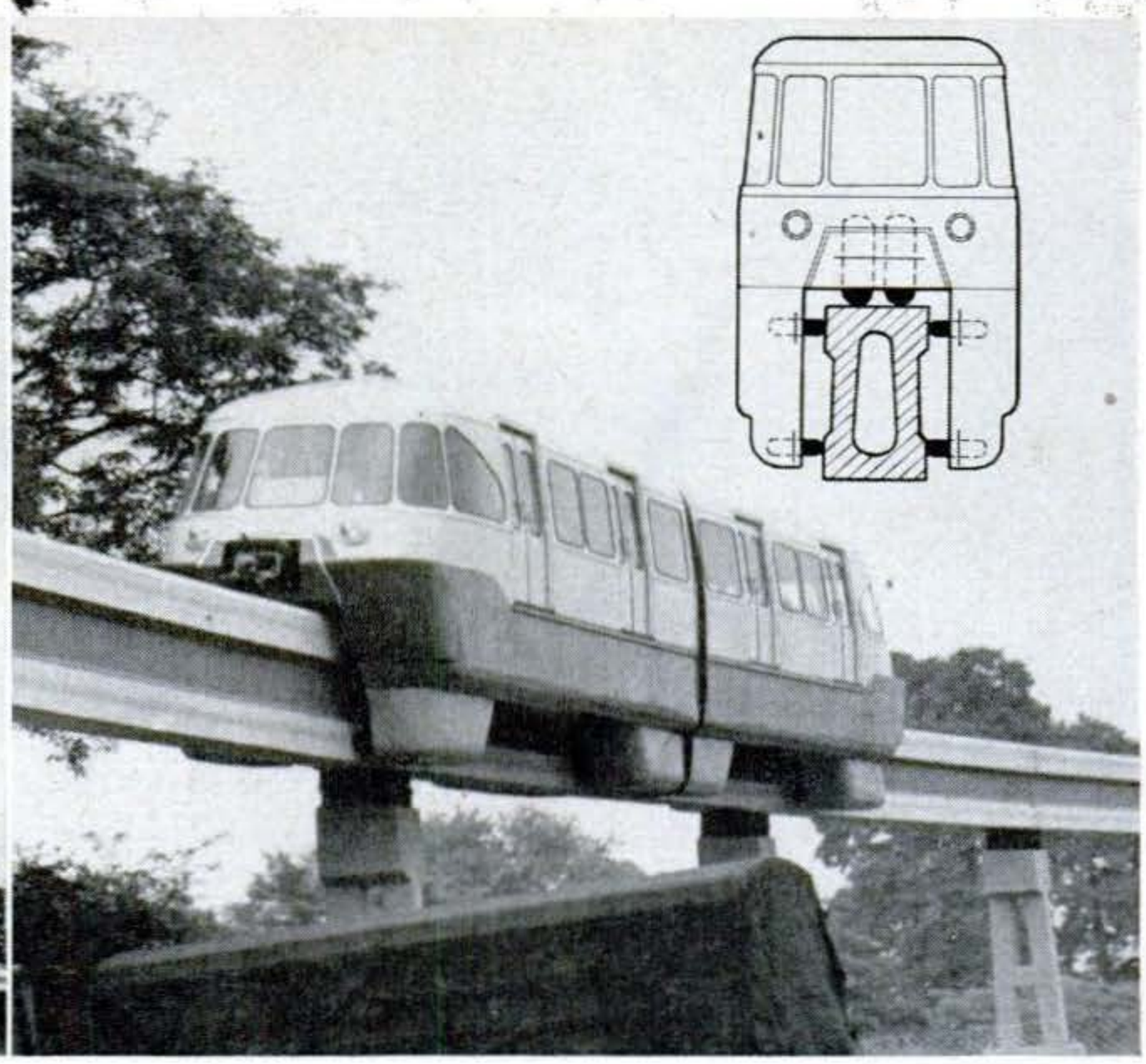

Monorail wheels cling to track on three sides

STRADDLING a concrete rail with pneumatic tires, this full-size, two-car monorail is being tried experimentally on a mile loop near Cologne, Germany. The train seats more than 60, hits 50 m.p.h. on two motors, and takes sharp curves. Track and stations use little ground space.

Telephone attachment plays music while caller waits

WHEN you keep somebody holding on at the other end of the line, the attachment on the back of the phone below lets him know you haven't hung up. It's a wind-up music box. Supplied by Gayle's, New York, it entertains a travel-agency customer here while his tour is checked.

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Thin chemical coating cuts reservoir evaporation

A FLAKY, insoluble chemical—hexadecanol—is being used to reduce evaporation in Western reservoirs three to eight feet a year. It is floated onto the surface from a doughnut-shaped dispenser. On 97-acre Rattlesnake Reservoir in Colorado, one eight-pound charge lasted two weeks.

Soft barrel tires let farm tractor go anywhere

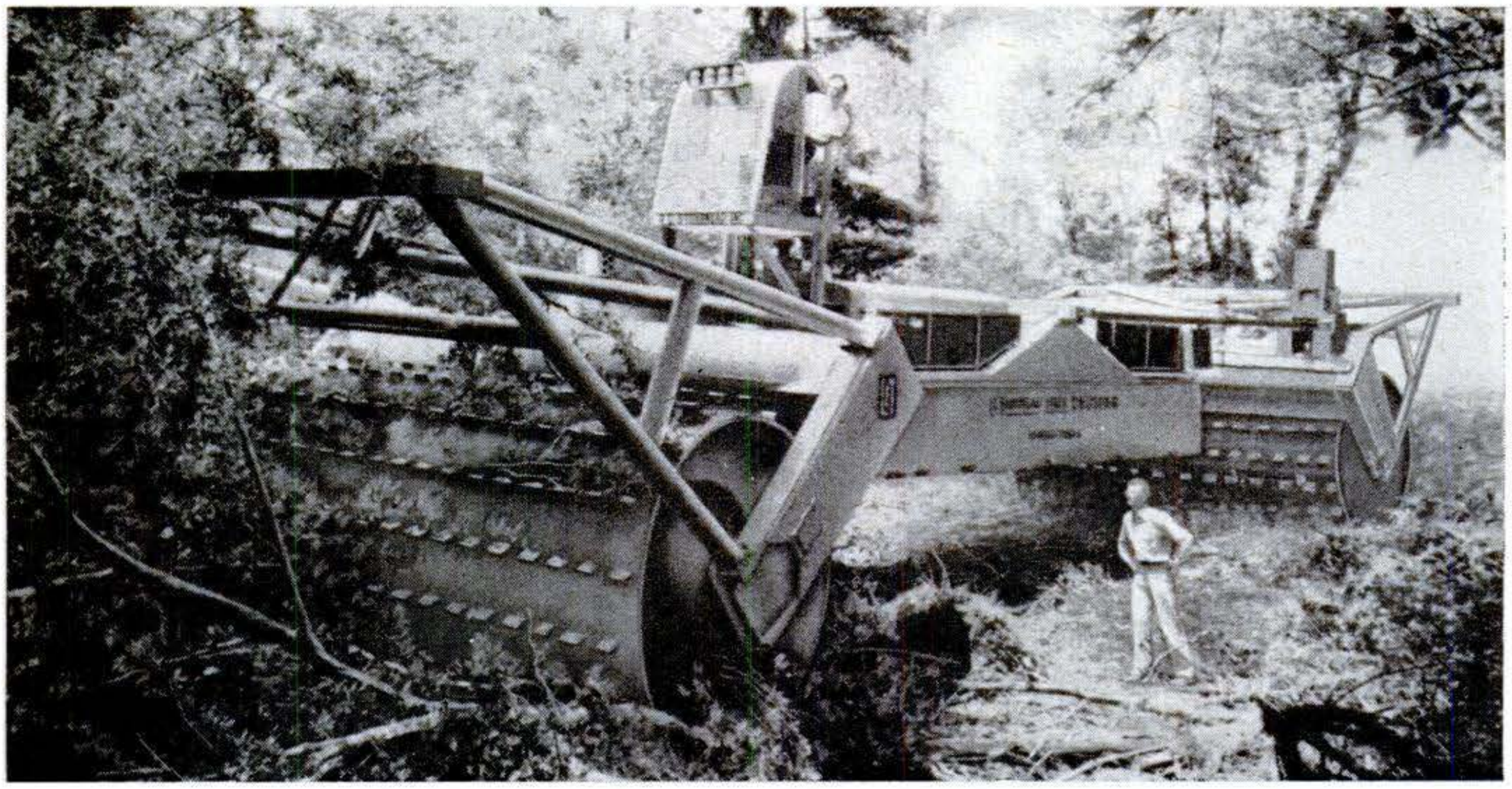
BUILT to use the low-pressure Terra-Tires developed by Goodyear for military vehicles, this tractor travels over rough ground, steep slopes, snow and mud. Atwood Vacuum Machine Co., Rockford, Ill., makes it for farm, oil-field and lumber work, and in smaller utility versions.

Flickering light to hypnotize enemy? Army hopes so

USING this screened searchlight that blinked some 500 times a minute, Army and Tulane University experts tested it for hypnotic effects. They hope to develop a weapon to put enemy troops to sleep, make them sick or dizzy. Tulane subjects didn't respond. The experts plan to keep trying.

Huge crusher clears acre of trees in quarter-hour

ONE man in the cab of this diesel-electric monster can batter a two-fifth-mile forest strip in 15 minutes, leaving a 20-foot path of pulp and splinters. The 280,000-pound tree crusher was built by R. G. LeTourneau to clear jungles for farms. Motors are in the nine-foot-diameter rollers.



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Aquatic telephones let skin divers talk under water

THIS swimmie-talkie uses water as a medium for sending high-frequency sound waves, on the principle of the hydrophone employed in the early 1900's for communicating between ships, and in World War I for detecting submarines. Being adjusted here on a frogman, the Aquavox includes a face-mask mike, transducer (on belt, left), transceiver (right), earphones (on thigh). Cotton Associates, Philadelphia, developed it.

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New PS Feature:

A Monthly Guide to Smart Shopping

THIS month and every month from now on, Popular Science brings you an exclusive guide to smart shopping. You'll find articles filled with ideas on shopping wisely, complete with descriptions, specifications, prices. Look for the latest on products for your home, your car, your shop, your leisure. You're undoubtedly already familiar with the regular PS new-product departments. The new Consumer News section will bring you these *plus* many fresh features, showing what to look for in a product, how to keep from making a mistake, and how to save time and money.

How to

They're alike in some ways, vastly different in others. The problem is finding the one that suits your shaving needs

By Robert Gorman

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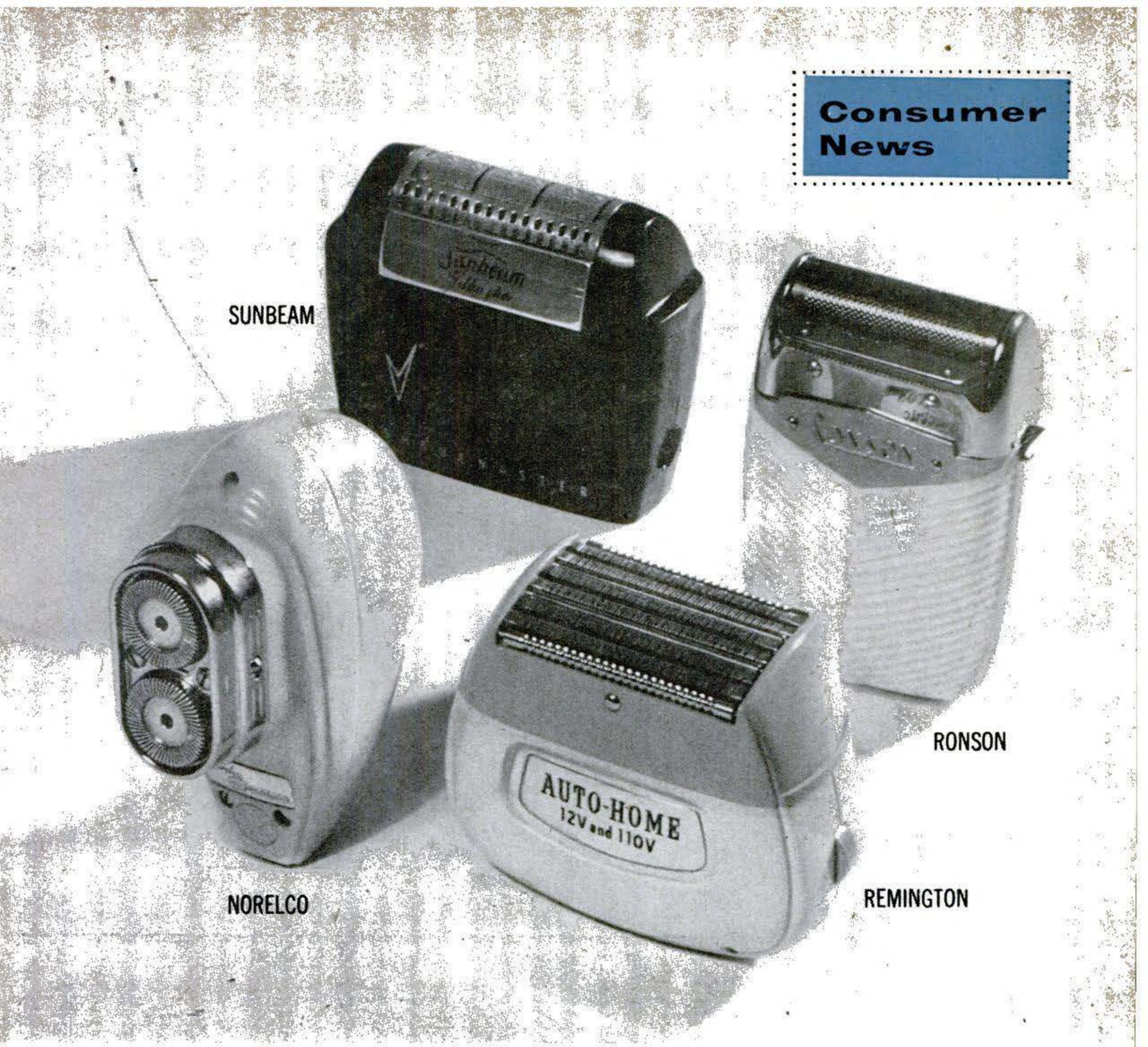

Buy an Electric Shaver

NO MATTER what weapon you use to whomp off your whiskers, there are four test questions by which to rate your daily shave. How clean is it? How long does it take? Does it irritate your face? How convenient is the method of operation?

To one man out of three the answers add up best with an electric shaver. Other men have tried electrics in the past and can't find a single good thing to say about them.

Now, here's news for such disillusioned one-time users and other skeptics:

Electric whisker-peelers have been getting steadily better. Among the current models, there's almost sure to be one that is right for any skin and beard.

But which one? Faster or closer machines aren't necessarily best for all, because beard patterns and skin types are individual. You can see why experiences vary so widely if you consider how shavers are alike and how they aren't.

How shavers work. All dry shavers operate on the same basic principle: They shear, or scissor, your beard. Unlike a straight or safety razor, which slices whis-

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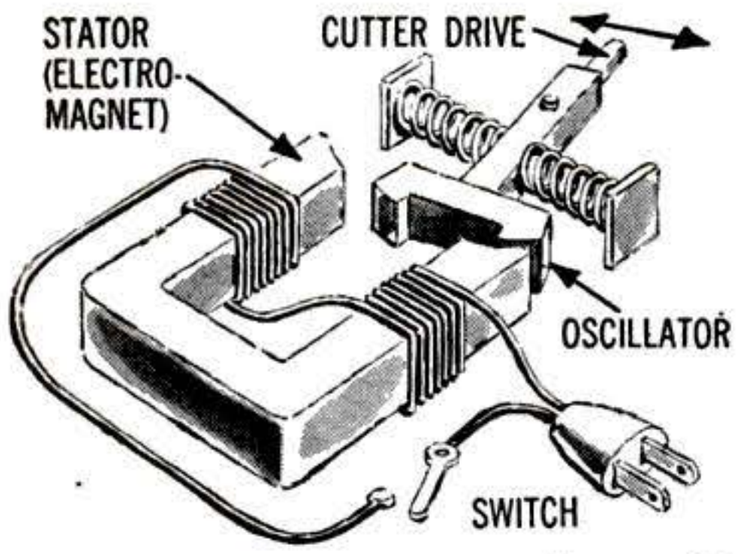
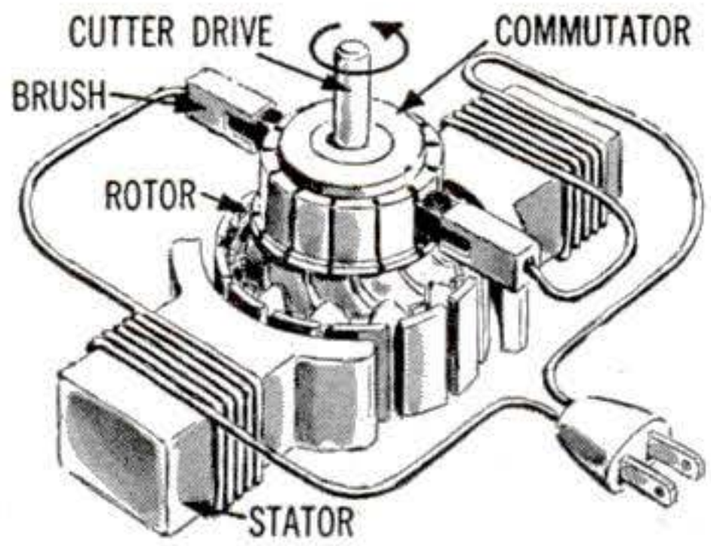
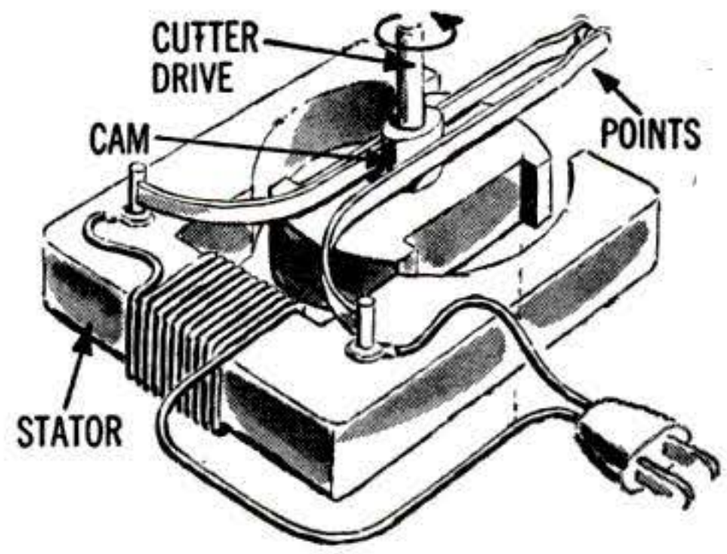
How electric shavers work: One of these three motors . . .



SYNCHRONOUS motor has a U-shaped electromagnet that alternately attracts and releases a pivoted, spring-buffered oscillator. It works off rising and falling AC-voltage pulses.



COMMUTATOR motor has series-wound coils on stator and rotor. Carbon brushes, riding on commutator, make and break the circuit to produce magnetic pulses that spin the shaft.



IMPULSE, or interrupter-type, motor has a lobe or cam on the rotor shaft that opens contact points twice per revolution. Resulting current make-and-break creates electromagnetic pulses.

kers, an electric traps each hair between two sharp edges and snips it off. One blade of each snipper consists of an opening in the shaver head or guard; the other is a motorized cutter that moves at high speed across the opening.

Resemblances end here. Shaver heads differ greatly in thickness as well as in size, shape, number, and arrangement of guard apertures. The cutter may be a single blade, or a cluster of them; it may oscillate from front to back, rotate like a windmill, or do its job with a reciprocating, side-to-side wiggle.

The thing to note about these differences is that many of them are simply *different*—not better or worse. Many of the variations are the result of compromises. In trying to create shavers that will be clean, fast and free of irritation, designers must face the fact that each of these three objectives is always at war with the others.

You get a choice. Keeping in mind

How the Shavers Compare

			STATIONARY HEAD OR GUARD				MOVING CUTTER			
MAKE	MODEL	MFR.'S LIST PRICE	Number of Heads	Thickness (in.)	Number of Apertures	Size of Apertures (sq. in.)	Type of Action	Speed (cycles per min.)	Cutting Actions Per Second	
BULOVA	Electric Razor	$35	1	.0027	1,600[a]	.00025	oscillating	6,500	125,000	
NORELCO	Speedshaver	$25	2	.0035	120	.0009	rotary	3,300	39,600	
	Sportsman	$25	2	.0035	120	.0009	rotary	2,000 on 3 volts; 4,000 on 6-12 volts	24,000 on 3 volts; 48,000 on 6-12 volts	
REMINGTON	Rollectric	$32	3	.0023	756	.0014	reciprocating	8,000	400,000	
	Auto-Home	$34	3	.0023	756	.0014	reciprocating	8,000	400,000	
RONSON	66A	$29	1	.0018	1,456[a]	.0006	reciprocating	14,400	698,000	
SCHICK	Varsity	$18	1	.0025	254	.001	reciprocating	7,200	173,000	
	Powershave	$30	2	.0025	508	.001	reciprocating	9,000	216,000	
SUNBEAM	Shavemaster	$30	1	.0018	1,750	.00025	oscillating	16,000	496,000	

Notes: n.a. This information not available. [a]Apertures and cutting action of auxiliary (side) trimmer not included in these figures.

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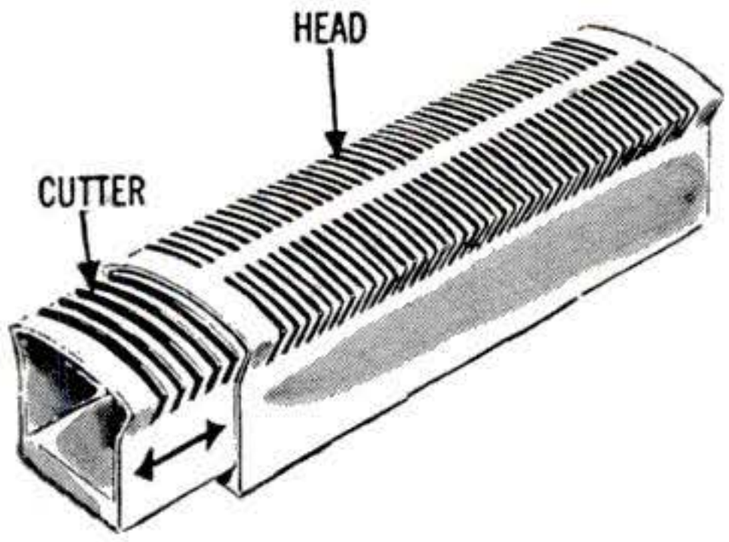
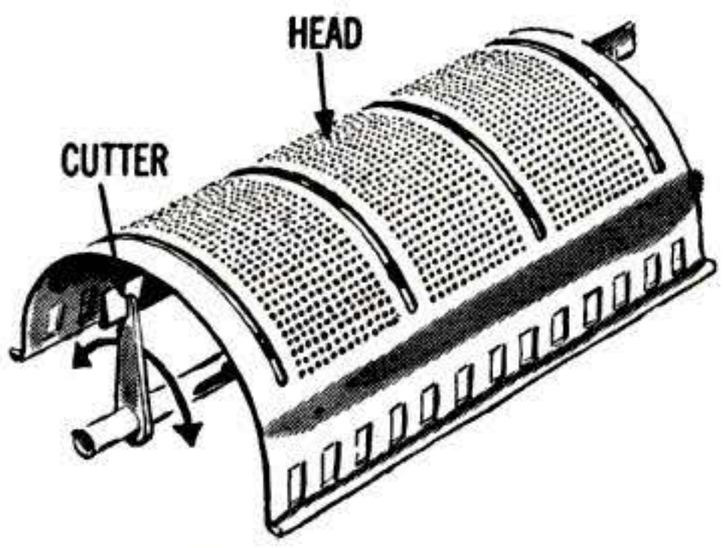
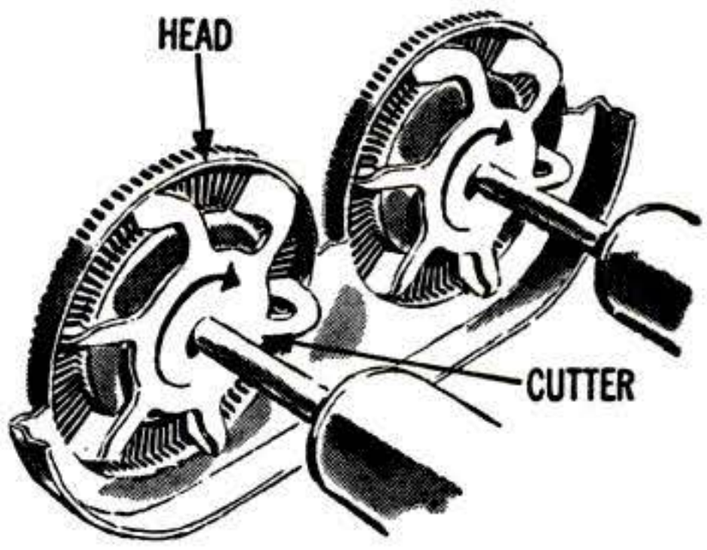
. . . drives cutters in one of these three ways



RECIPROCATING cutter moves from side to side below (or inside) perforated shaver head. One or more cutter knives whisk past each opening in the head on every cutter cycle.



OSCILLATING action is very similar to reciprocation except that the cutter blade—or blades—sweep a wide arc from front to back of the semicircular head or guard of the shaver.



ROTARY cutter, as its name suggests, simply spins around. Unlike both other types (which move in two directions) this cutter can be driven directly by a rotary-motor shaft.

these compromises in design will help you shop. *Thickness of the guard* on the shaving head is important. A heavier slab of metal keeps the cutting business farther away. That may mean a shave that's less irritating—and not so close. A thinner guard could be right for the man whose skin can take a close shave.

Another compromise you might consider is the tie-in between irritation and shaving time. In order for the clippers to get at more hair more quickly, the perforations in the head should have *large areas*. If the holes are too large, however, an uncomfortable amount of skin may squeeze in—and get sheared—along with the beard. (If the aperture sizes in the chart seem small to you, remember that the cross-sectional area of a hair is much smaller than its diameter.)

The time it takes you to shave may also depend on the *number of whisker openings* in the guard and the *rate* at which the shearing blades whisk by. The combination (leaving aperture size out of the reckoning) may be roughly summarized in terms of cutting actions a second.

The amount of snipping that goes on is measured in astronomical numbers. In the course of an ordinary shave, the scissors may snip a hundred million times.

Obviously a lot of this action goes to waste. Each individual whisker may be chopped anywhere from two to 50 times. Then, too, cutting action doesn't have any useful effect unless hairs are poking through the apertures. But while every shaver busily shaves air a large part of the time, a higher rate of cutting still should help to shorten your daily tussle.

Consider the head openings. Some manufacturers insist that the *shape* of head apertures is more important than their size. Proper slope, contour and position, they say, permit guard openings to raise whiskers and funnel them to their doom. Among the listed models, Remington and Schick feature slotted openings; Bulova, Ronson and Sunbeam have essentially round holes; Norelco uses slots in a radial pattern.

How do you select yours? The first step is to consider the kind of shave

		MOTOR			MAINTENANCE	
	Cutter Hardness (Rockwell C Scale)	Type of Motor	Operating Voltage	On-Off Switch	Service Intervals (mfr.'s recommendations)	Replacement Cost of Cutter & Head
	60	commutator	115 AC-DC	no	2 yrs.	n.a.
	66.5	commutator	115 AC-DC	no	1½-2 yrs.	$5.00 (both heads)
	66.5	commutator	3 DC (battery pack) and 6-12 DC (car plug)	no	1½-2 yrs.	$5.00 (both heads)
	63-65	impulse	115 AC-DC	no	6 mos.	$4.50 (each head)
	63-65	impulse	6 DC[b] and 115 AC-DC	no	6 mos.	$4.50 (each head)
	60	synchronous	115 AC	yes	1 yr.	$3.25
	56-58	synchronous	115 AC	no	6 mos.	$2.50
	56-58	impulse	115 AC-DC	yes	6 mos.	$2.50 (each head)
	n.a.	commutator	115 AC-DC	no	indef.	$3.95

[b]Also available for use on 12-volt car battery and 115 AC-DC.

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How to use a shaver

BEFORE you plug in a new shaver, read the instructions. Even if you've owned one, chances are your new model is *not* used the same way. For example: Some shavers won't do well under pressure. Bearing down on one of these increases irritation without giving you as good a shave.

Second, wash your face and dry it well before shaving. Whiskers hold some of the water and swell up, becoming easier to cut. Washing also removes cutter-dulling grit. Drying is important so surface moisture won't cause shaver drag. When you can't wash, try a preshave lotion. Don't use talcum. It may dull and clog cutters.

Finally, to attack whiskers that grow one way on your cheek, another under your chin, vary the approach. The principle: Maneuver the shaving head into *lifting* (not flattening) the hairs, so your shaver's openings can trap them.

SELF-CLEANER: With head lifted off, Ronson cleans itself under power. You can blow clippings out of some makes; others need a brush.

you're looking for and the degree of your skin sensitivity.

Then check on some factors that may affect the life of your shaver, its maintenance cost, and its convenience in use. Cutters with higher Rockwell hardness ratings, for example, may reasonably be expected to hold their edges longer. This might be important if your beard is exceptionally tough.

Accidents—such as dropping a shaver—can't be figured on, but neither can they be ruled out. So the cost of replacing vulnerable parts is something to ponder.

And of course a shaver's power requirements should match the ways you plan to use it. The chart shows two dual-voltage models that can be used in your car. The Norelco Sportsman will also operate on its own battery pack, and Remington's Auto-Home doubles as a regular house-current shaver. With two exceptions, all the 115-volt models may be plugged into DC as well as AC outlets. In some areas this may be a convenience, especially for men who travel. But the synchronous, AC-only motors have the virtue of causing no radio or television interference; AC-DC motors may.

Another convenience angle: Most shavers can be turned off only by disconnecting the line cord, but a few models have an on-off switch.

About price: In most parts of the country you can buy an electric shaver for considerably less than its list price, either on a straight discount or on some kind of trade-in deal. But whatever the tag, look for a store that will let you try the shaver. Free home trials are the best way to tell if a shaver suits you.

Because of different shaving techniques—and the need to "retrain" your beard—your first efforts may leave your face pretty raw. So allow the model you select at least a week to prove itself.

Then let your face give the verdict. Unless you have some special problem, at least one of the new electrics should give you a neat and bloodless shave—with a happy balance of speed and comfort. END

NEXT MONTH: Thinking of buying a portable electric saw? An article in January PS will give you all the facts. Complete with spec chart, of course.

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Want to make music? Experts say you're a rare bird indeed if you can't learn. As a starter, here are the facts:

Before You Buy a Musical Instrument

By Wesley S. Griswold

THE U. S. is in the midst of the biggest play-it-yourself boom in musical history. Around 28,000,000 people in this country now play some instrument—nearly twice as many as 20 years ago.

Why are so many people making music? Students of the melodic boom say it's a product of the tense, fast-paced times.

There's a common longing, they say, for a good way to "let down." Nearly everyone has both more leisure and a need for a relaxing way to spend it. Physicians have long prescribed music-making to soothe nerves and lighten spirits.

Can everyone play? Hardly anybody is

GROUP MUSIC pulls you out of the wallflower class—good reason for buying an instrument.

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so tone-deaf, uncoordinated and non-rhythmic, music educators believe, that he can't learn to play some kind of instrument. And once he starts playing, he must coordinate eyes, ears, fingers and sometimes breathing or feet. As a reward for his efforts, he gains the real thrill of being able to produce tunes.

This he achieves just playing by himself. If he joins a group of other amateurs, he soon finds that half the fun lies in fumbling along and correcting mistakes in tolerant company. In such a welter of concentration and good humor, who has room in his mind for worries?

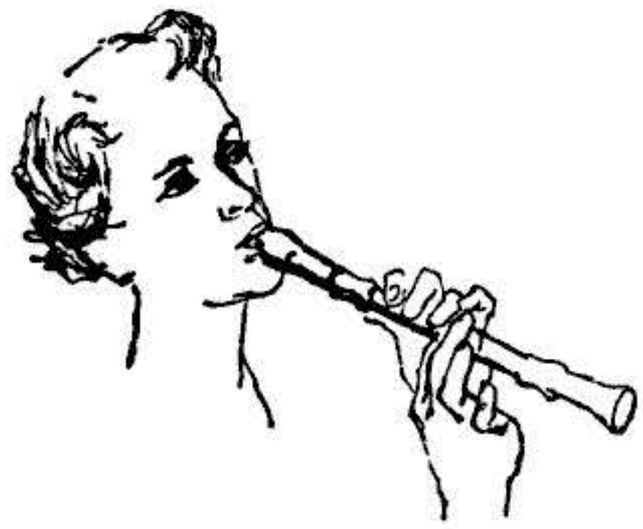
Scarcely anybody but the dedicated musician bothers with tedious scales and similar exercises any more. The modern teaching trend is to start a beginner right in on tunes.

Often, the instrument you buy or rent comes with a book of simplified instructions so that you can pick out old favorites without a teacher's help.

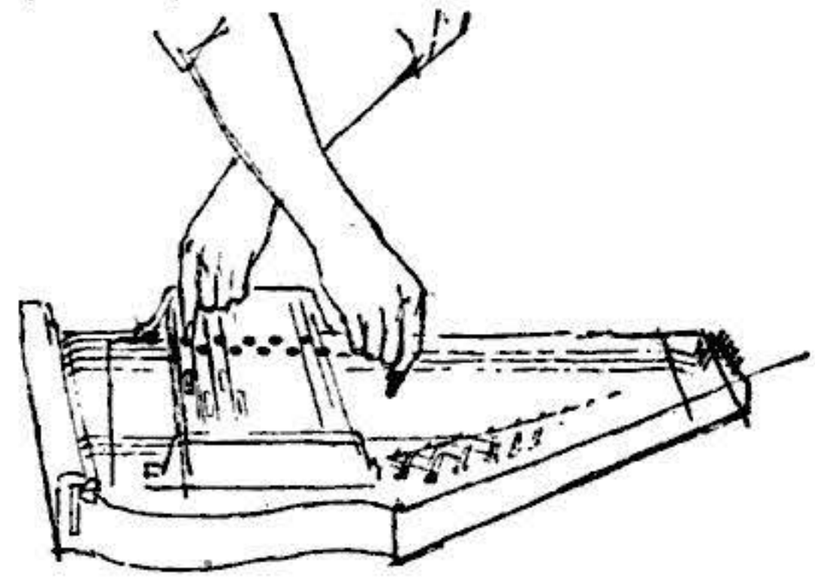
If you crave a surer grasp of the instrument, there is now a way to gain it that makes a social game of what otherwise might become a lonely chore. You can learn by joining a group of amateurs, all equally new to the game, who are being coached by one teacher, a roomful at a time. It's a great way to rid yourself of self-consciousness.

The standard course for such a class—increasingly common in school adult-education programs—provides 12 hours of instruction. At the end of that time, each player is usually advised to continue with private lessons. The cost of private lessons these days runs from about $2 an hour in small towns to $5-$10 an hour in cities.

The zest of so many eager but musically innocent people to join in the new national pastime has created a special flurry in the easy-to-play instrument market.



ONE great favorite is the recorder, a small, tubular, wooden wind instrument with a flutelike tone. It's about as simple to play as a shepherd's pipe and nearly as ancient. Recorders come in five "voices": soprano, alto, tenor, bass and sopranino, which has a higher range than the soprano. You play a recorder by placing fingers over holes in the instrument and blowing. (The bigger ones have a single key near the outer end.) You can easily learn to play one from an instruction book, and enjoy it alone or as part of a group. Recorders will set you back from $4 to $150.



ANOTHER very popular, easy-to-play instrument is the Autoharp. It is small, light, looks like a zither, and is held in one's lap and strummed. It has steel strings and a number of wooden "chord" bars. Each bar wears a little label with the name of a chord on it (C-sharp, E-flat, etc.). On the bottom of each bar are felt dampers with spaces between them. When you press down on the C-sharp bar, for instance, and strum the strings of the Autoharp with your free hand, the dampers under the bar prevent all strings from sounding except those that play notes in a C-sharp chord. The Autoharp ranges in price from $20 to $45.

Then there's the chord organ, a fast-rising newcomer. It looks pretty much like other electronic organs but is winning friends at a brisk rate by being a cinch to learn to play. It has half a keyboard, for the right hand. In place of the part of a standard keyboard normally devoted to bass notes, it has a row of buttons. Each button, when punched,

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What instruments are Americans playing?

SOME 20,000,000 Americans thump pianos, 4,000,000 strum guitars and 3,000,000 play violins and related string instruments (violas, cellos, bass viols), according to the American Music Conference of Chicago.

More than 2,000,000 blow woodwinds (flutes, clarinets, piccolos, saxophones, oboes, bassoons). Nearly as many sound the more stirring brasses (trumpets, cornets, trombones, baritone and alto horns, mellophones, Sousaphones, French horns, tubas). Another close rivalry in numbers exists between those who plunk ukuleles (1,600,000) and those who squeeze accordions (1,500,000). Organists (875,000) are growing rapidly, numerically speaking, thanks to new electric and electronic home organs. Even the humble harmonica, which ranges from bite-size to a whopping three-footer, has 400,000 fans, including President Eisenhower.

electronically produces a particular chord, which ordinarily would be the work of several fingers of your left hand. By following a kind of blueprint that comes with the organ, you can quickly find out which buttons to punch to provide an agreeable, full-bodied accompaniment to whatever tune you are able to pick out with one finger on the instrument's pint-size keyboard. Chord organs cost from $985 to around $1,100.

That long-time delight of kids and cowboys, the harmonica (costing from 50 cents to $100), must also be mentioned among the instruments that are easiest to learn to play. Next in order of difficulty for most people come ukulele, guitar, banjo, accordion, piano, standard home organ, woodwinds, brasses and finally string instruments.

IF YOU hanker to join the crowd of Americans now making their own music, here are some practical points to consider:

Though most musical instruments cost a respectable amount of money, and some are very expensive, all can be bought on time-payment plans. Furthermore, music stores generally are willing to rent any instruments they sell, giving the renter an option to buy at the end of three months and use his rentals up to that time as a down payment on the purchase price. The monthly rental is customarily from five to 10 percent of the cost of the instrument, if new; five percent, if used. Regardless of the purchase price, though, $5 a month is about the rock-bottom rental and $50 a month—for the best grand piano—about the top.

If you want to learn to play an instrument, you might be wise to rent it until convinced that your choice was sound and your chance of playing well is bright.

Used instruments are often available, but here, as with second-hand cars, it's prudent to stick to reliable dealers, or to buy from the original owner, if you know he has taken good care of it.

In shopping for musical instruments, keep in mind that an inexpensive one usually does not limit your choice of music, just because it's cheap. You can play anything on a $100 violin that you could play on one costing $100,000. There are a few cases, though, in which you might be lured by a low price into buying an instrument on which it is impossible to play all the music you may be capable of producing.

How about a lone-wolf instrument? Unless you start out with a well-developed yen to play a trumpet or a bongo drum or a harp more than anything else, you had better first consider the class of "self-sufficient" instruments. These need no accompaniment to give listeners pleasure, and, in addition, provide agreeable accompaniment for other instruments and for singers. They include the Autoharp and chord organ, already discussed, and also the:

PIANO ($500-$7,500)—most popular of all musical instruments, and the only one, except for the standard home organ ($695-$4,000), that is also an attractive piece of furniture. To play either,

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you have to learn fingering for both hands. The piano is easier to master than the full organ, which has foot pedals (for deep bass notes) and knobs, levers, flip switches or extra keys to change tone quality. Small pianos available at a minimum price have only 64 keys, 24 fewer than the standard size. You can't play all pieces on them.

ACCORDION ($40-$1,500)—This is nearly as versatile as the piano and, moreover, is portable. It has a piano-like keyboard for one hand, an array of buttons for the other, to play bass chords. Coordinating bellows action with the fingering of keys and bass buttons is tricky at first, but, seasoned players say, it gradually becomes second nature.

You can't cover as much musical ground with a 12-, 25- or 80-bass accordion (the numbers indicate the number of bass chords you can play on it) as you can with the 120-bass professional type. The price difference? Accordions with curtailed bass start at $40, 120-bass accordions begin at $300.

FRETTED instruments—These include the ukulele ($1.39-$75), cheapest and easiest to play of the group; mandolin ($20-$200); banjo ($45-$300); and guitar ($20-$500). To play any of these, you learn fingering for one hand (normally the left), while picking or strumming the strings with the other. Frets, raised strips of metal across the finger board, make it easier to learn where to place your fingers.

HARP ($1,500-$5,000)—Here's the only other self-sufficient instrument. It is difficult to learn to play, rough on the fingers, and few people have the money or inclination to tackle it.

All other instruments—woodwinds, brasses, strings and drums—need accompaniment. If you want to play one of them, you had better find an orchestra, band, ensemble, or, at least, a pianist.

WOODWINDS—For the most part, these have reed mouthpieces, though two of them—the flute ($100-$1,800) and the piccolo (same price range)—are played by blowing gently across a lip hole. All woodwinds require fingering with both hands. The saxophone ($200-$650) is the easiest to play. Next come clarinet ($75-$600), flute, piccolo, oboe ($150-$650) and bassoon ($150-$650).

BRASSES—These require fingering of only one hand. The trumpet and cornet (both $75-$250) are almost identical, and are the easiest to play. Then, with the going progressively tougher, come the trombone ($75-$250); alto horn

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($150-$300); mellophone ($100-$350); French horn ($100-$375); baritone horn ($160-$350); tuba ($400-$900) and Sousaphone ($515-$740).

STRINGS—These instruments, though the exceptional charm of their music is a reward for the effort, are the most difficult of all. If anyone has ever told you that you were singing off-key, don't take up the violin, viola, cello or bass viol. For them, you must have a sure sense of pitch. Though the strings require you to learn fingering for only one hand, you must learn to place your fingers with great accuracy and with no frets to guide you, in order to produce a note that is true. At the same time, your other hand must master the bow. If you move it across the strings diagonally, you'll sound a false note. If you don't exert just the right amount of pressure, you'll produce an unpleasant sound.

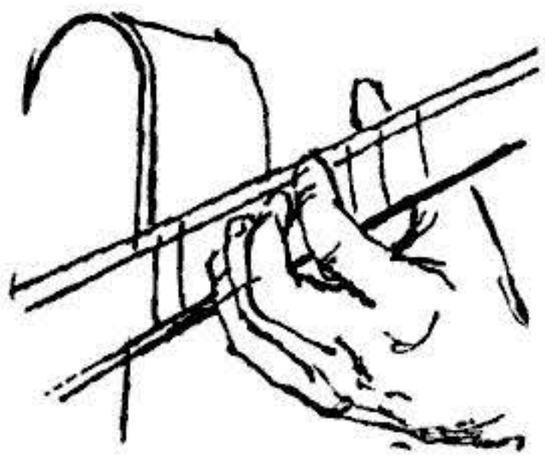
Violins, which come in a number of substandard sizes to accommodate small hands, start at $25, violas at $40, cellos at $60 and bass viols at $200.

DRUMS—These are for the man who was born with a sure sense of rhythm. If you are stricken with the calypso fever, get yourself a bongo ($7-$100) or a conga ($18-$100) drum, both of which are sounded with bare hands. If your enthusiasm is more conventional, you will prefer a snare drum (starting at $40), played with sticks, or possibly a full set of drums ($400), including cymbals and bass, to give your feet a share in the fun.

Many a music educator believes that nobody should attempt to learn to play a musical instrument before the age of seven. There is scarcely any *top* limit, though. A Chicago manufacturer took up the violin at 65, when he retired. Now, in his seventies, he plays in a suburban string quartet. With oldsters? Not exactly. Two of the four are teen-agers. END

NEXT MONTH: The story of the most sensitive instrument of them all—the human ear. Read "The Wonderful Way We Hear" in January Popular Science.

Physical traits may determine how well you can play



SMALL HANDS? Better avoid the guitar. It requires long fingers and a wide reach. However, you might consider buying the three-quarter size.

SHORT ARMS? One instrument not recommended in that case is the trombone. To play this well, you need all the reach that nature endowed you with.

IRREGULAR TEETH, a sharp jaw, thin lips? These are all points in your favor in case you'd like to play any of the woodwinds, experts have found.

REGULAR TEETH, a round jaw, full lips? These features are in your favor if you want to play a brass instrument, with its wide, round mouthpiece.

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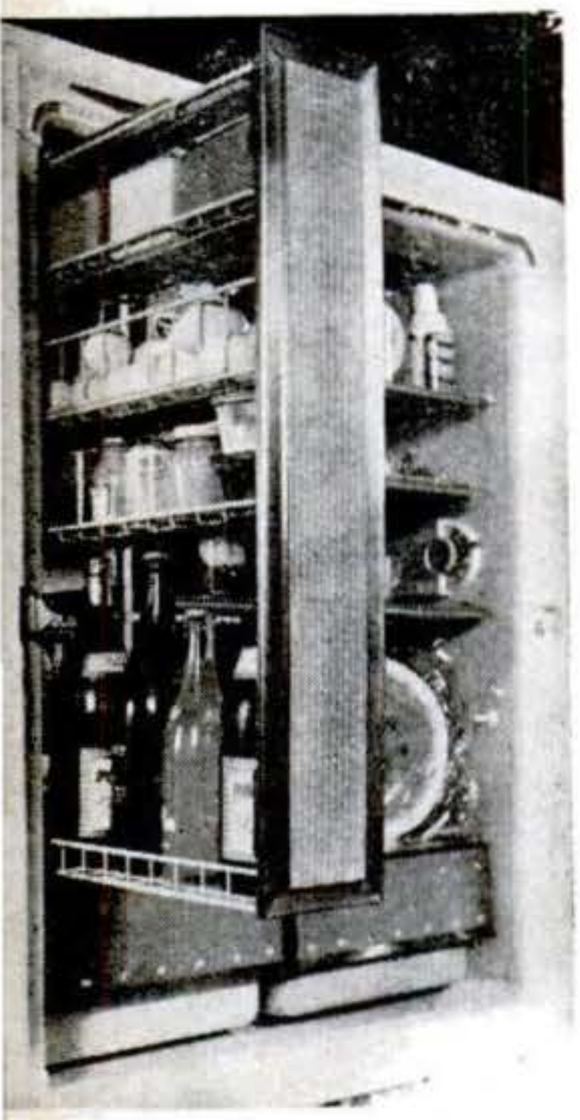
what's new

for your home

An indoor barbecue that's gas-fired from small, disposable propane tanks makes it easy to broil sizzling steaks all winter long. You just perch it in any fireplace, as shown above. In summer, you can also use the portable grill outdoors. The tiny tanks—the same kind used in many gas-fired blowtorches, lanterns and camp stoves— fire up instantly, eliminating the fire-building chore. Each tank lasts about two hours, then you remove the empty and hook on a new one. The burner heats the underside of a porous ceramic block at the bottom of the grill so that no flame reaches the meat directly. How do you get the fine outdoor flavor? It's the fat and juices dripping into the fire, says the maker, that smoke the meat. The grills, made by Bernz-O-Matic, come in two sizes: 12″ wide with one burner for $30; 18″ wide with two burners for $50.



New filters are made to stop dirt and scale from getting into hose-fed washing machines, pumps, lawn sprinklers and sprayers. The Trump filters fit standard garden-hose couplings in place of the regular washers . . . ***Latest aid in refrigerators*** is a full-length slide-out rack (at left) that lets you easily reach the stuff that's stored way in back. It's available in the new Sears line.

Here's a switch from cold to hot: two new thermostats are designed to simplify your furnace controls. One has up to five push-buttons for easy touch-selection of heating, cooling, air circulation and manual or automatic operation. Made by White-Rodgers, it also has an interlock arrangement that makes it impossible to turn on a furnace and air-conditioning system at the same time—which can happen where separate thermostats are used. ***For those***

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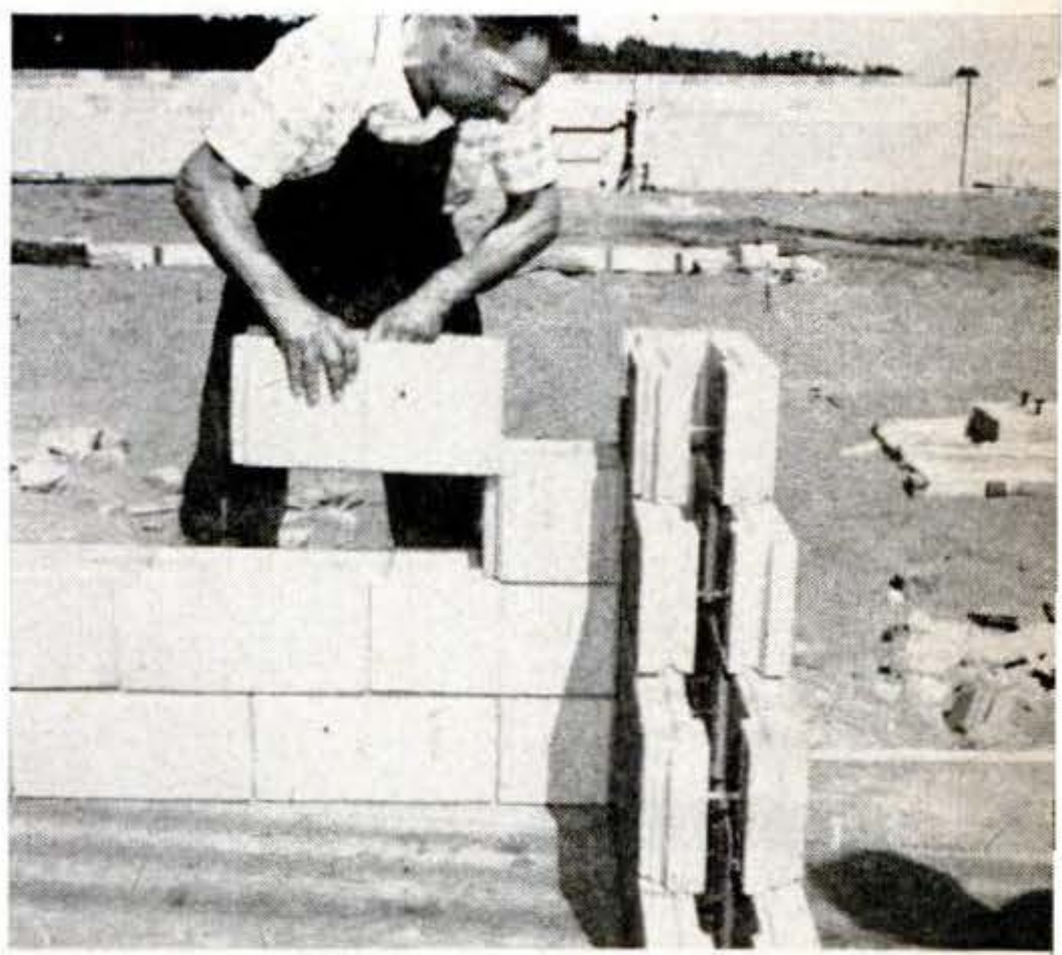
who want a clock thermostat, there's a new Minneapolis-Honeywell model with an automatic time switch that turns down the heat for any interval during the day as well as at night to save fuel. You can set it to go off when you leave, come back on before you get home . . . Speaking of heat, ***you can now put a furnace in your window*** just as you would an air conditioner. The new Fedders unit at right is actually a compact heat pump that supplies both heat in winter —by working like a refrigerator in reverse—and cool air in summer. A single thermostat turns on either one as you need it. Each unit costs only about $50 more than an ordinary air conditioner alone, its makers say—and you get a furnace to boot. The electrically operated units can be used singly for supplementary heat or, with one in each room, to take care of the whole house.

Other heat pumps, including a central GE system small enough to fit in a closet, may indicate a new trend in the making. ***Are heat pumps economical for you?*** They are, say experts, *if* your electrical rate isn't too high. ***For those who prefer gas*** as a fuel, there's also a year-round gas-fired conditioner. The Perfection-Hupp model is not a heat pump, but provides a similar kind of winter heating and summer cooling in a single compact unit.

for the home handyman

Speedier cleanup after painting, always the worst part of the job, is claimed for a new Mira-Spin tool. You just hook on a solvent-soaked brush or roller, pump the revolving handle a few times, and it's said to clean out paint by a fast spinning action . . . ***Watch your lumberyard*** for new interlocking concrete blocks (below) that automatically give you straight, level walls. You just stack them in place dry, then add mortar in the joints later. Air spaces between the blocks provide insulation, keep out moisture, even let you run plumbing and electrical lines right inside. The two halves of each block are held together by steel cross bars embedded in the concrete. Where extra strength is needed, tie bars can be run through the walls. The Presto Brick Machine Corp. designed the new blocks . . . ***Want to display your favorite guns*** quickly and safely? A new type of individual hook-shaped bracket can be screwed anywhere to the wall, one at each end of the gun, saving a lot of gun-rack carpentry. The rubber-covered Gunberth brackets come in two sizes, will hold both hand and long guns.



If you are worried about ceiling tiles covering up important plumbing and electrical fixtures, here's an answer. You can install a hinged, metal access door (bottom right), then fit a matching tile into the recessed face of the door. The Milcor doors come 12″ by 12″, 12″ by 24″, and 24″ by 24″, and will take all types of tiles.

[More new products on the next page]

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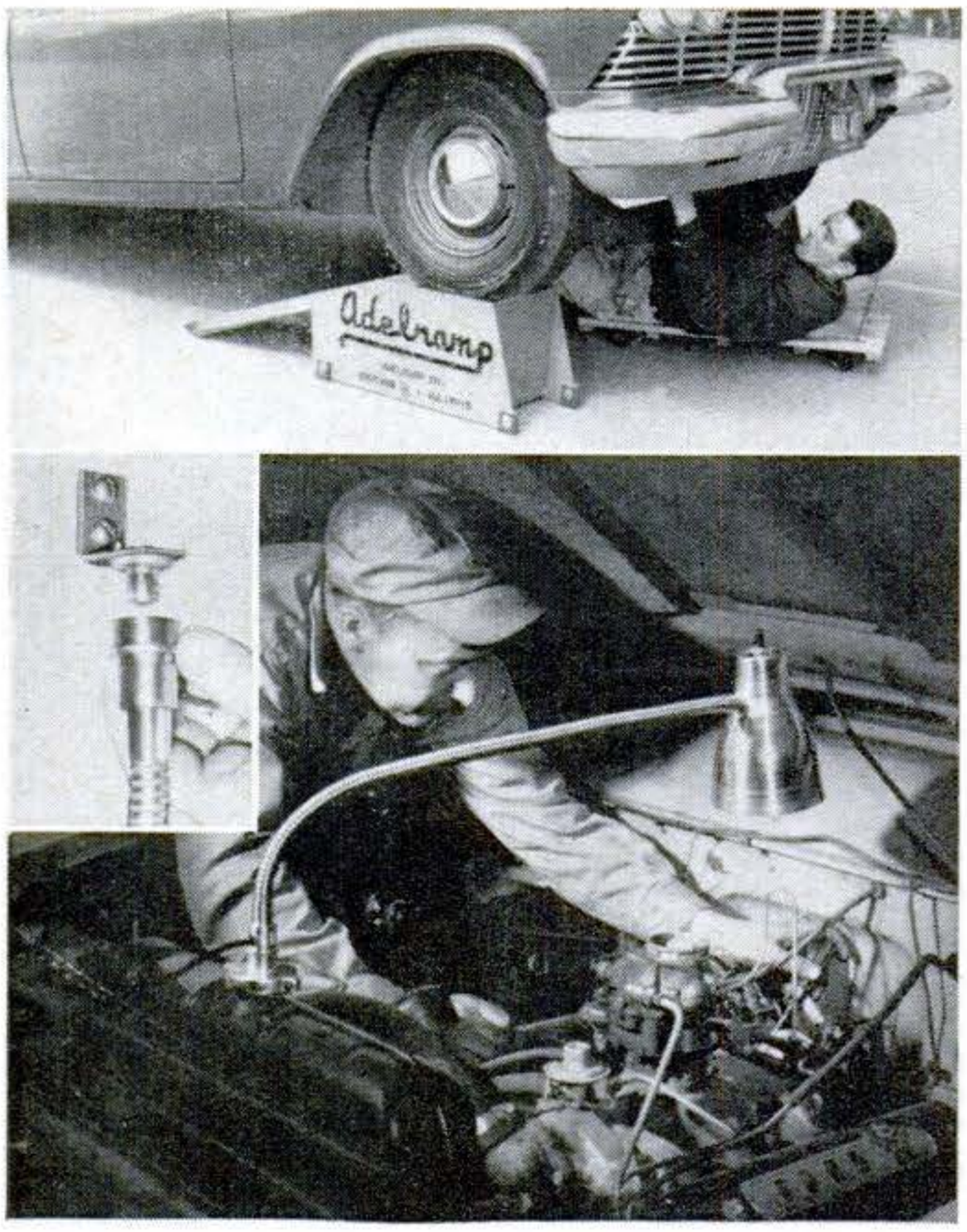
what's new for your car

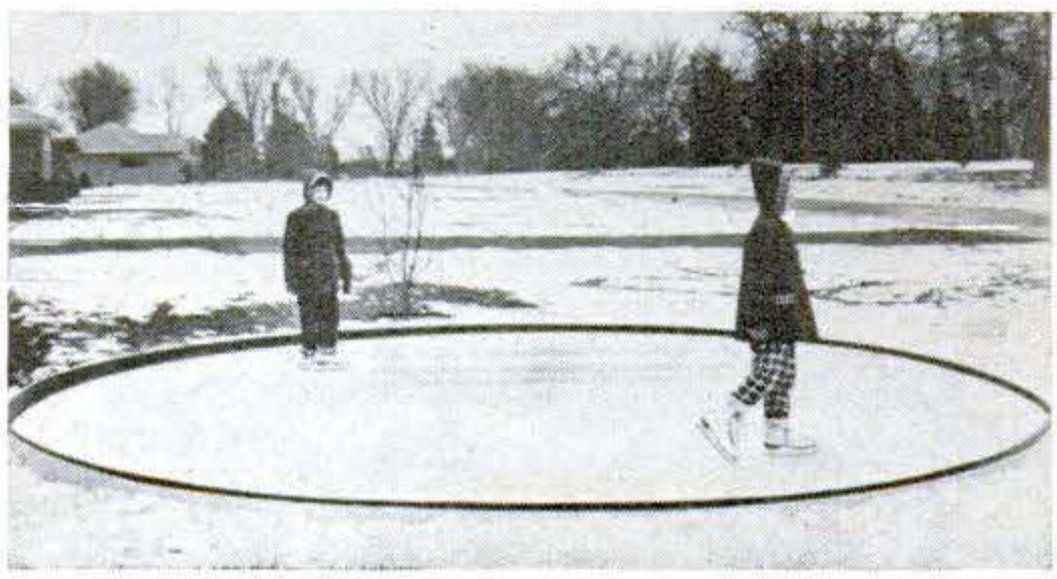


Drive onto these twin ramps (top left) and you can work safely under a car without danger of slipping jacks. The steel Adelramps have nonslip rubber feet and wheel pockets to prevent roll-off. Yes, you can back up on them, too . . . ***Good working light,*** another important aid to car care, is the aim of a new Moffatt swivel lamp. You can buy it already mounted on a radiator cap for underhood work, as at left, or with snap-in connectors (inset) for use on power tools, workbenches, walls or desks . . . ***The wrong kind of light*** can be kept out of your eyes with a new anti-glare dashboard coating made by Arndt-Palmer. It's a clear vinyl finish, doesn't hide the color . . . If you've been worried by recent warnings about ***high-speed tire distortion*** (PS, Oct., p. 84), the B.F. Goodrich people have an answer: a new all-nylon-cord tubeless tire that's said to eliminate wobble even at 110 m.p.h.

for your leisure hours

Bigger baby outboards may be a trend to watch for, as indicated by a husky new Wizard fishing motor for '58. Power is up to 5½ hp. over last year's five, displacement up from seven cu. in. to nearly 9½. Yet weight (55 lb.) is still under many engines of this size. The motor will troll down to one m.p.h., hit up to 15 m.p.h., and has a reverse gearshift . . . ***Two new camera items*** are in the moderate-price department. One is an imported Japanese single-lens reflex camera that offers three interchangeable lenses for a total cost of about $278. The Kalimar uses 120 film, has automatic shutter cocking and is synchronized for both strobe and flash. Camera with standard 80-mm. f/3.5 lens is $99.50. A 150-mm. f/4 telephoto costs $79.50; a 52-mm. f/3.5 wide-angle, $99.50.

To light your pictures indoors or out, there's also a ***portable electronic flash*** that works on either flashlight batteries or house current for about $60. The new Graflex unit has 1/1,100 second duration and gives up to 100 flashes before batteries need replacement . . . ***You can have a back-yard skating rink*** any time the weather is below freezing with the circular plastic liner shown at left. You just fill it with 2″ to 3″ of water—like a very shallow plastic swimming pool— and let it freeze. Made by Urb Products, the liners come in four diameters from 15′ to 35′ for $20 to $75 . . . ***You can change records*** without getting up from your chair on a new Admiral console. The remote control—with no wires; it works by sending ultrasonic waves— also tunes the TV set and adjusts radio volume from anywhere in the room.



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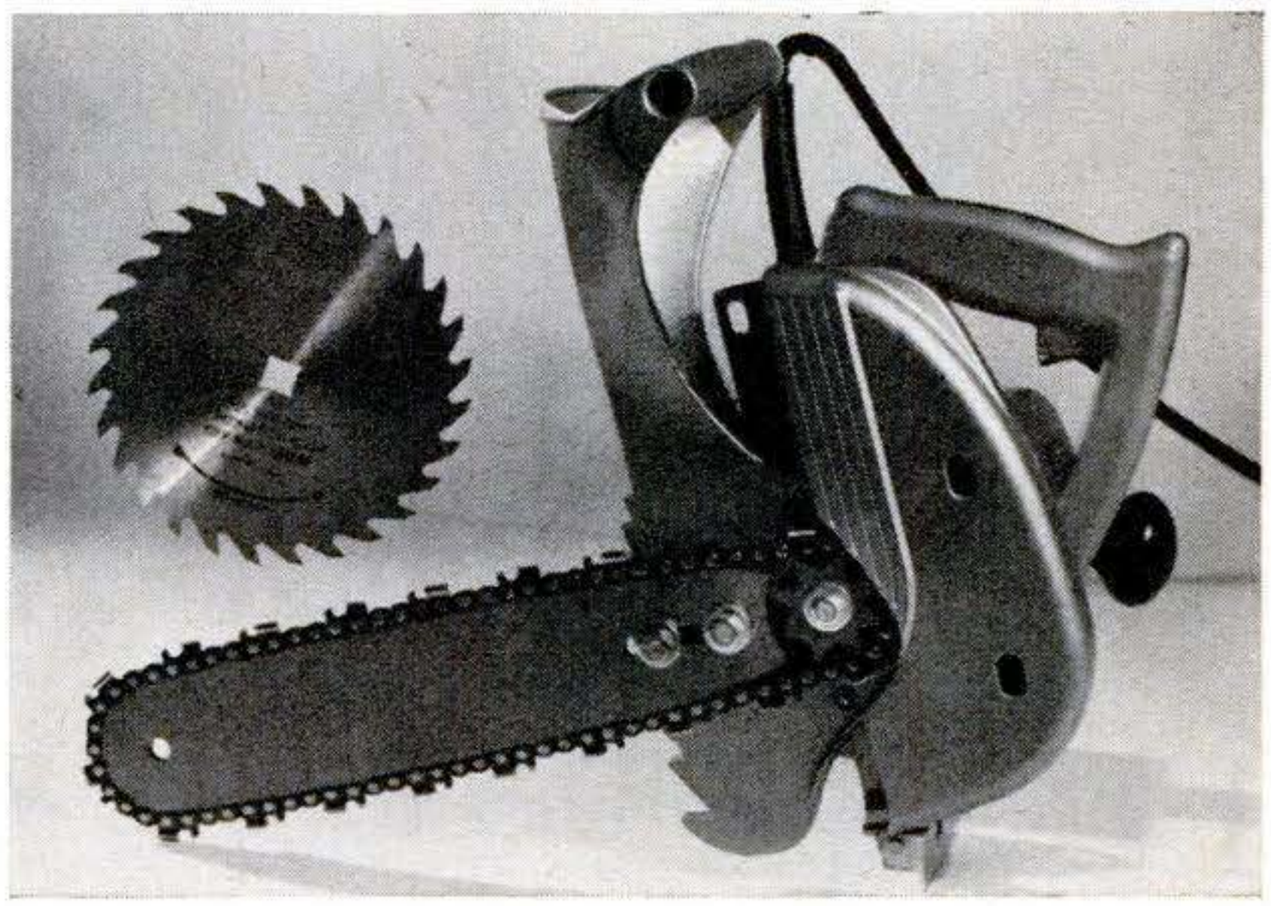
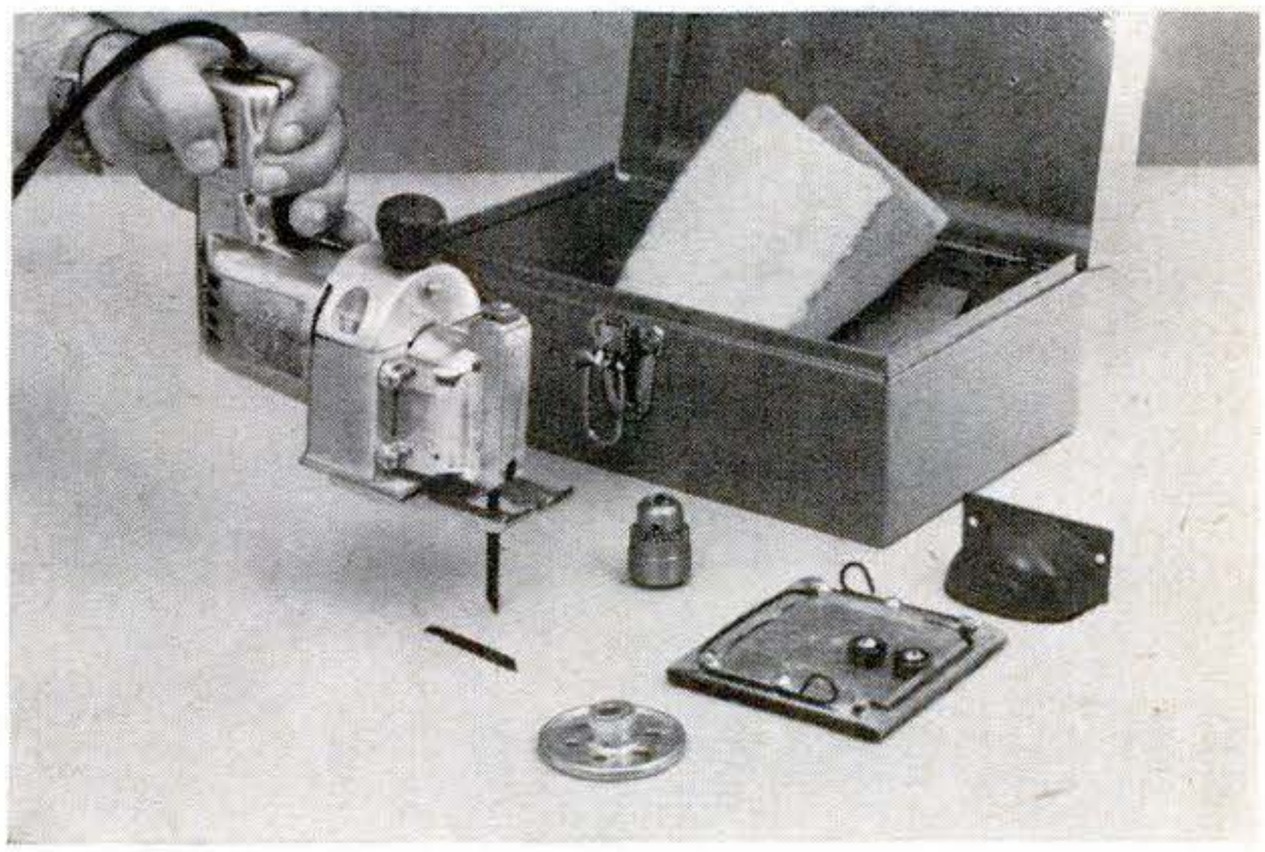
for the home shop

Multi-purpose tools are the trend today. One of the neatest is a ***universal socket wrench*** that saves you carrying a full set of separate sockets or fussing with several sizes to find the right fit. Its jaws adjust like a chuck to grip all sizes and shapes of nuts from 3/8″ to 3/4″. Made by the Alliance Tool Co., the socket itself, without handle, sells for $5.95 . . . Another all-in-one tool is a ***three-way screwdriver*** that gives you a choice of a wide or narrow straight blade or a Phillips blade. The blades swing out from the handle, which also provides a forward or reverse ratchet action. It's called the Versatool. . . .

A convertible chainsaw-handsaw (below) offers a novel switch. You remove the circular blade and insert a sprocket wheel that drives a 12″-long chain attachment. It will cut timbers up to 9″ thick and has a blade speed of 2,500 feet per minute. Made by Portable Electric, the tool has a kickproof slip clutch and sells for $79 complete . . . ***Another new portable circular saw*** doesn't convert to anything, but does offer a lot of cutting at a modest price: $59.50. Made by Porter-Cable, it has a kickproof clutch, ball-bearing drive and is said to make all professional cuts including compound miters in stock up to 2″ thick . . . ***An electric drill that also saws and sands,*** at lower right, uses a new method of converting. Instead of fitting attachments into the chuck, like other accessories, you actually build a whole new tool to do each job. To saw, you remove the chuck and install an offset drive that powers a reciprocating saber blade. To sand, fit on a wobble wheel that drives an oscillating sanding shoe. The Thor kit comes with all the parts packed in a steel case for $37.50.





Sheldon Gallager

for more information:

Here's where to write if you can't get any item listed above: **Adelramp Co.,** *5912 W. Chicago Ave., Chicago 51;* **Admiral Corp.,** *Chicago;* **Alliance Tool,** *287 E. 6th St., St. Paul 1, Minn.;* **Arndt-Palmer Labs,** *Melvindale, Mich.;* **Bernz-O-Matic,** *Otto Bernz Co., Rochester, N.Y.;* **B. F. Goodrich,** *Akron, Ohio;* **Fedders-Quigan Corp.,** *Maspeth, N.Y.;* **General Electric,** *Bloomfield, N.J.;* **Graflex,** *Rochester 8, N.Y.;* **Gunberth,** *Coladonato Bros., Hazleton, Pa.;* **Kalimar, Inc.,** *1909 S. Kingshighway Blvd., St. Louis 10;* **Milcor,** *Inland Steel, Milwaukee 1;* **Minneapolis-Honeywell,** *Minneapolis 8;* **Mira-Spin,** *Kruger Products, Fenkell P. O. Box 5582, Detroit 38;* **Moffatt Products,** *4824 Triton Dr., Minneapolis 22;* **Perfection Industries,** *7609 Platt, Cleveland;* **Portable Electric Tools,** *Chicago 20;* **Porter-Cable,** *Syracuse 8, N.Y.;* **Presto Brick Machine Co.,** *350 5th Ave., N.Y.C.;* **Sears, Roebuck,** *Chicago;* **Thor Power Tool Co.,** *Chicago 1;* **Trump,** *Animal Trap Co., Lititz, Pa.;* **Urb Products,** *55 Meadow St., Brooklyn 6, N.Y.;* **Versatool,** *Eagle Products, Meriden, Conn.;* **White-Rodgers Co.,** *1209 Cass Ave., St. Louis 6;* **Wizard,** *Western Auto Supply, Kansas City 8.*

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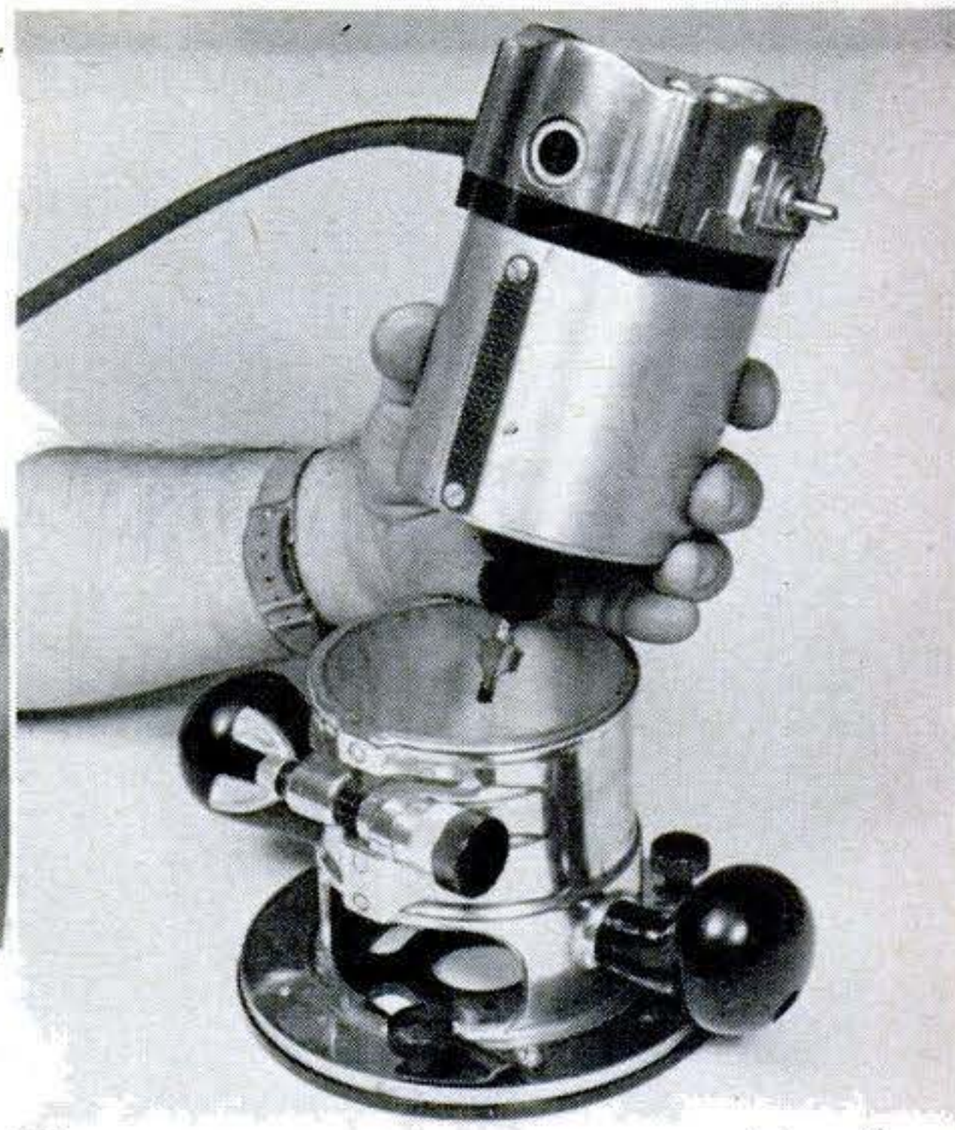

RACK is located on the motor housing, the pinion gear on the router base. The rack can be replaced if worn or damaged.

New Router Adjusts

DEPTH adjustment of a new Black & Decker router is provided by rack-and-pinion. You turn a knob to raise or lower the power unit. A pinion gear on the base meshes with a rack screwed to the motor housing.

Because the housing moves straight up and down instead of being rotated, the switch is always in the same position relative to the handles. You don't have to search for it for instant shut-off.

To set the working depth, you first bring the router bit—locked in the chuck—lightly down on the work surface. You then set the dial—it slips around the shaft of the depth-adjustment knob—to this zero cutting depth. After "zeroing in" the scale, you turn the knob to lower the bit to the desired depth, indicated in 64ths of an inch on the dial. A large wing nut locks the setting.

The router is powered by a heavy-duty ¾-hp. motor operating at 19,000 r.p.m. You get the router, a smooth plastic sub-

Sheet Steel Backs Up New "Sandpaper"

AN ABRASIVE that is said to outlast sandpaper 100 to 1 is being produced by brazing tungsten-carbide grits on sheet steel. The tough grits, permanently fixed on their steel base, stay sharp indefinitely and can be cleaned of gum or paint with a wire brush or solvent.

The Skil Corp., 5033 Elston Ave., Chicago, makes the new abrasive in six forms for home-shop use, all shown on the facing page. They are a two-sided sanding disk for table saws priced at $12.95 (you can use the edge for cutting); a sanding block at $3.45 for fine and coarse hand sanding; a 14″ file at $2.25 with fine and coarse sides for shaping wood by hand; and grit shoes, at $2.95 each, in a wide range of grit sizes for orbital sanders. Grit sleeves and rods are also made for industrial spindle-sanding machines.

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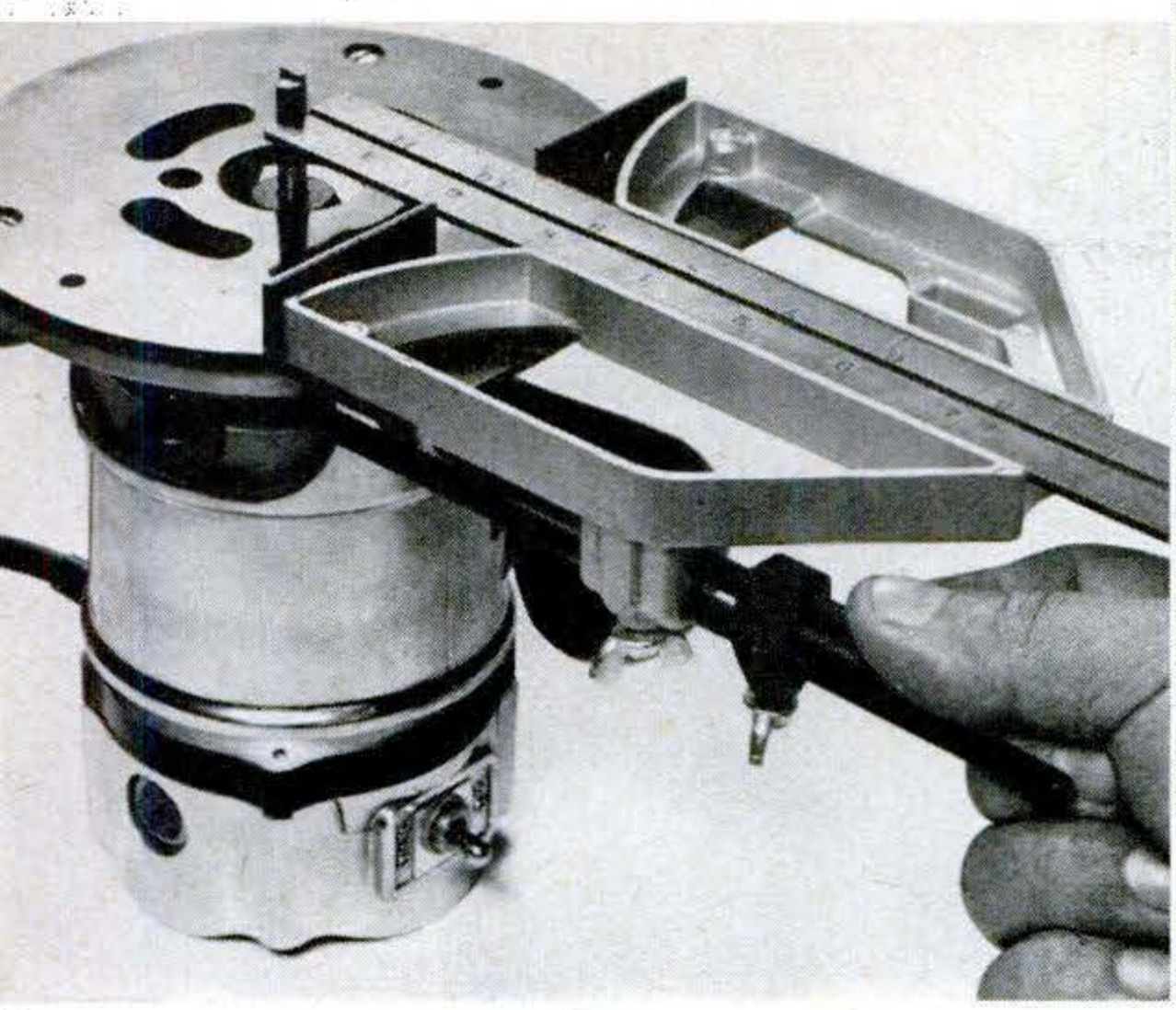
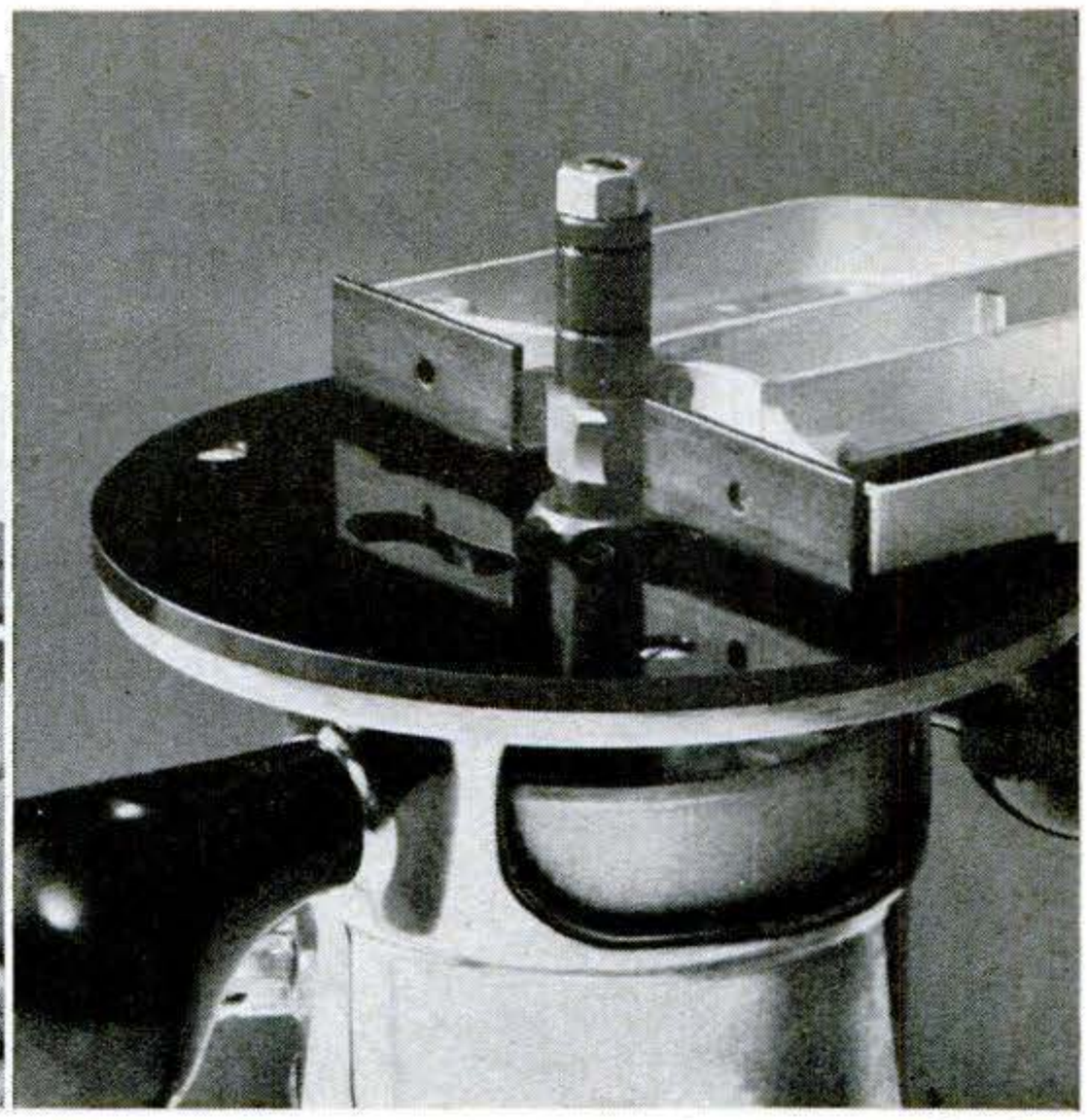


METAL RULE, or scale from a combination square, fits in 1″ groove in underside of router's edge guide for accurate measurement of the distance to cutting edge of a bit or cutter.



SHAPER CUTTERS are mounted on a special arbor that locks in the chuck. They can be used singly or in a large number of combinations to produce a variety of edge cuts and moldings.

by Rack-and-Pinion

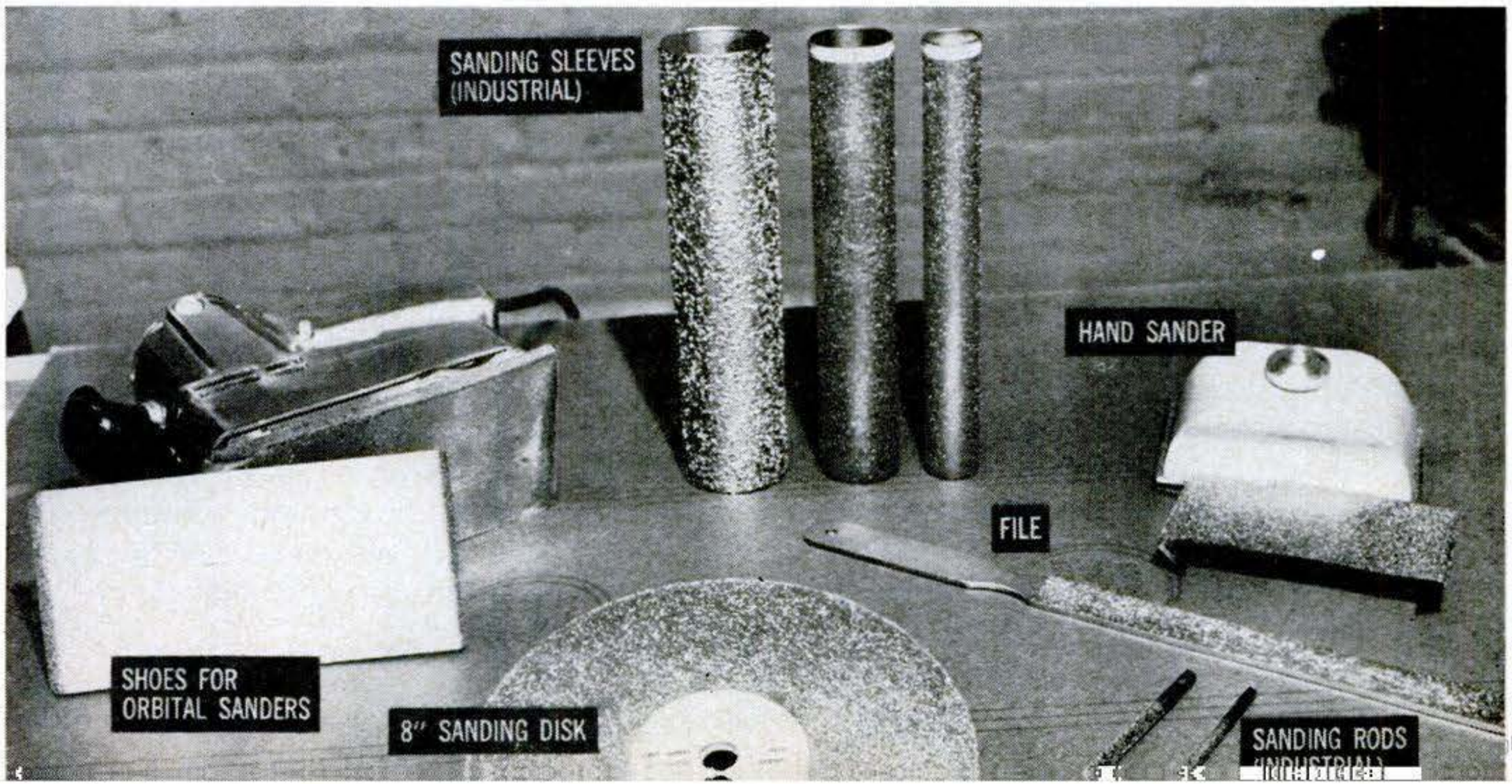
base, chuck and two wrenches for $59.50.

The motor housing has a flat top with air-intake slots arranged so that the router can be stood on its head for sharpening bits and cutters. High starting torque makes it necessary to hold the tool firmly when starting. At operating speed, it stands quietly on its flat top while you use the bit-and-cutter sharpener ($17.50).

Router attachments include a straight and circular guide ($6.50) for routing or grooving parallel to the edge of straight or curved work; and a slot- and circle-cutting attachment ($6.75) that equips the router for cutting evenly spaced grooves, circular holes and concentric designs.

A dovetail kit consisting of a work-clamping fixture, finger template, template guide and bit—everything needed to cut precision dovetails in two mating pieces at one time—can be had for $39.50.

Builders and carpenters will find a hinge-mortising kit priced at $55 a time saver for hanging doors and shutters.



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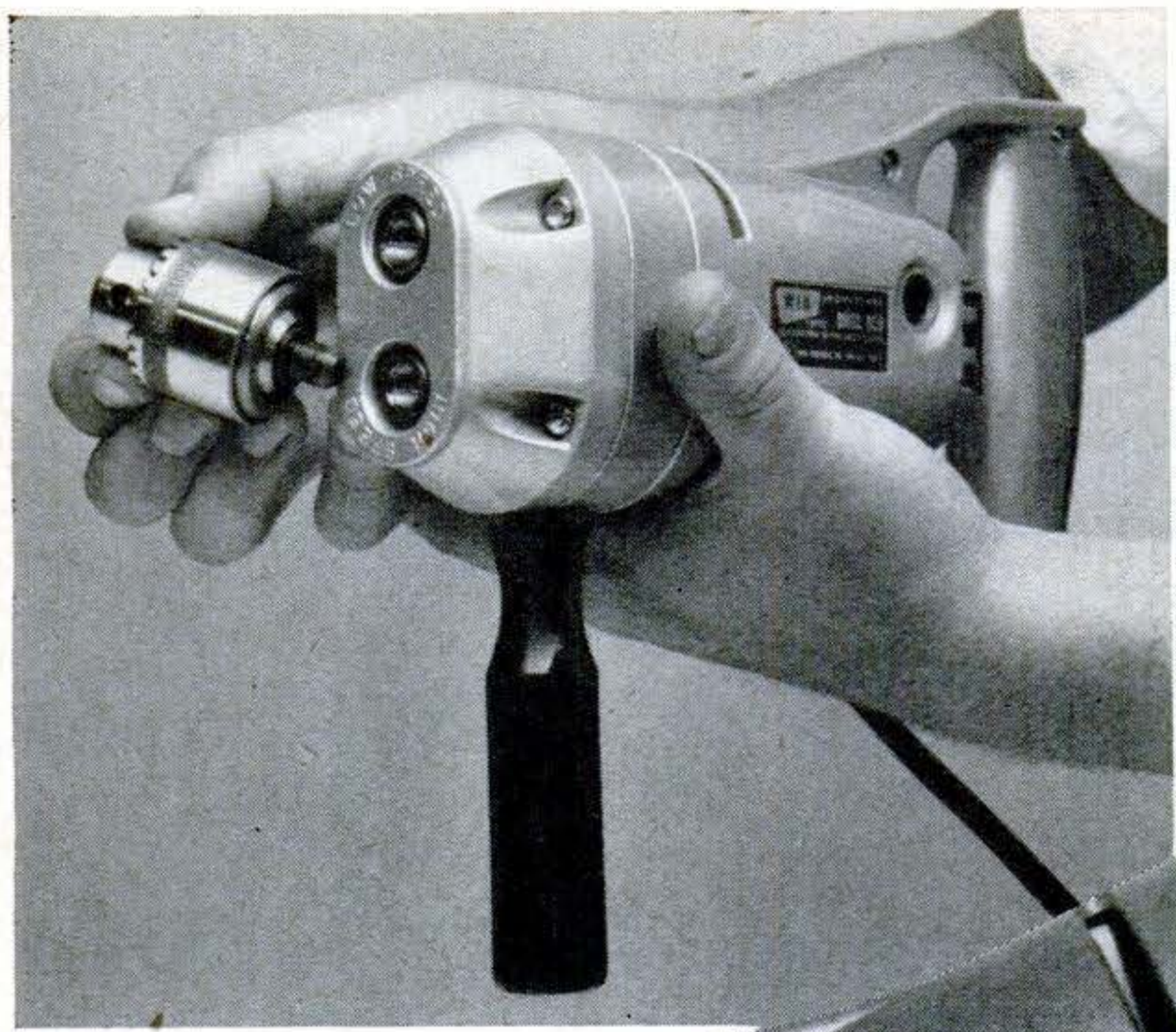
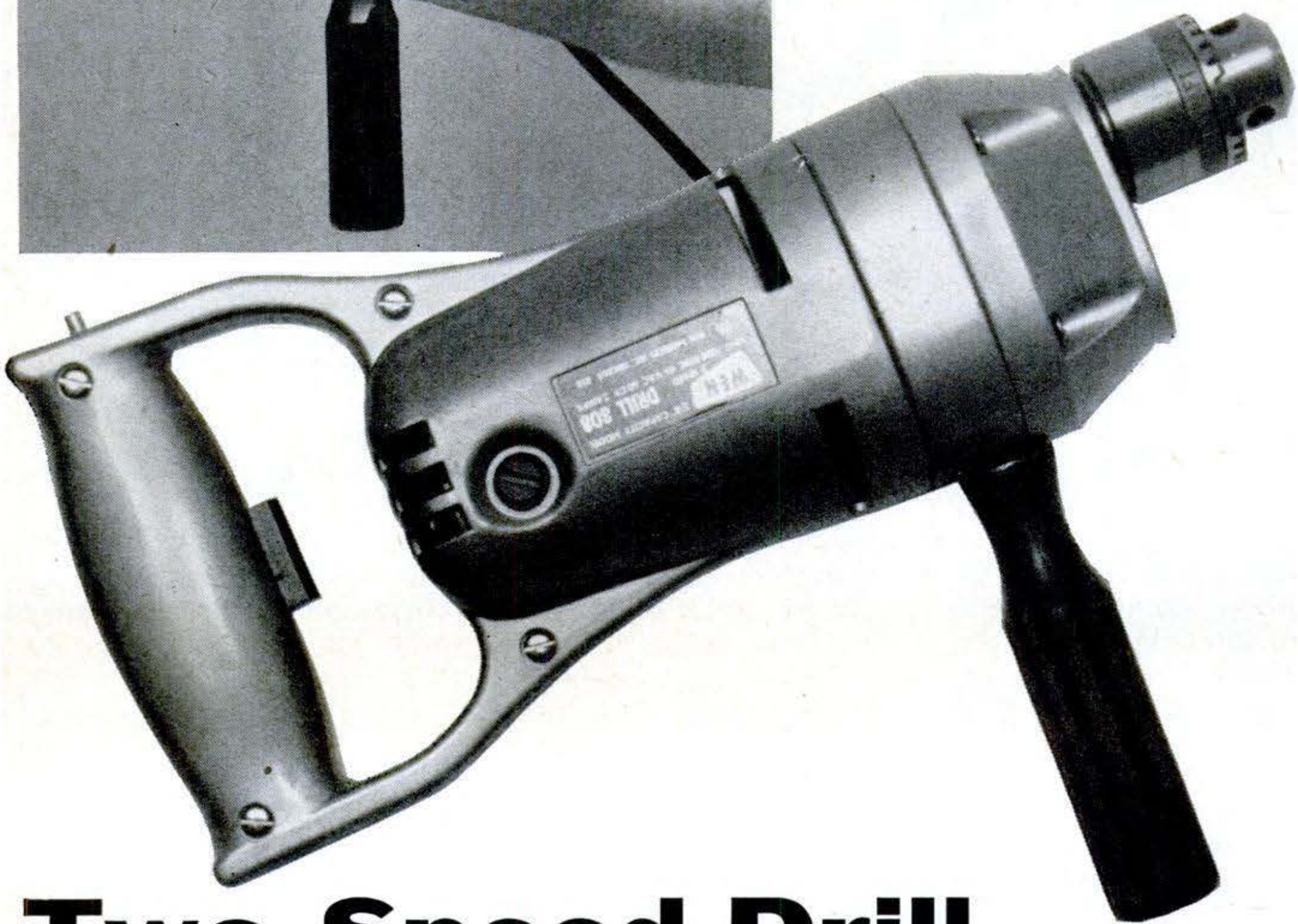


SPINDLES TURN TOGETHER—you screw the chuck in the one you want to use. Dual spindles, used instead of a gearshift, cut cost. Cap keeps unused spindle clean.

DRILL CAN BE INVERTED as below for handling ease when the lower spindle is used. The drill body is symmetrical and the auxiliary handle attaches at top or bottom.



Two-Speed Drill Does Double Duty

TWO speeds—1,000 and 3,000 r.p.m.—have been built into a new ⅜″ electric drill. This gives it the capacity to handle practically all jobs.

You use the chuck in the high-speed spindle for drilling sheet metal and wood, and for such accessory jobs as disk sanding, rotary sawing, grinding, polishing.

When heavy jobs turn up, you remove the husky ⅜″-capacity chuck and screw it in the spindle geared for low speed, converting the drill to heavy duty. The gear reduction provides the higher torque needed for drilling thick metal and masonry, and for boring large holes in wood. The slow speed is also better for such jobs as driving screws, mixing paint and rotary waxing with a wool bonnet. A dust cap snaps over the unused spindle to keep the threads clean.

The manufacturer, Wen Products, Inc., 5804 Northwest Highway, Chicago 31, says that the drill, priced at $29.95, is the equivalent of two.

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This New Mount Gives You a One-Motor Shop

TWO-PART MOTOR MOUNT now on the market consists of a pulley base and a motor base (you supply the motor). Centrifugal clutch coupling on the motor shaft slips into clutch drum on the pulley base. Bases fit all power tools.

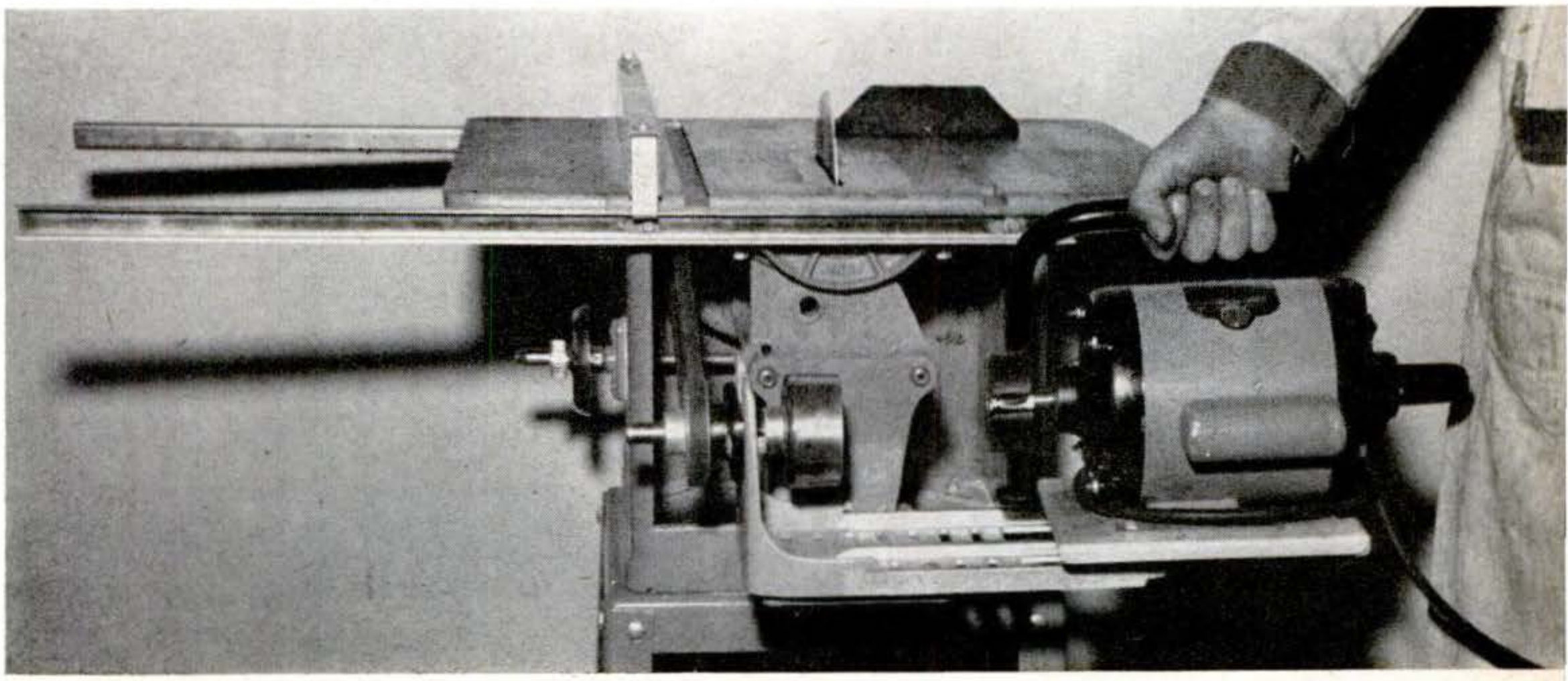
A NEW snap-on mount makes it easy to operate all shop tools with one motor. The change-over from one tool to another takes only seconds and there is none of the inconvenience that often cancels out the advantages of a single-motor workshop.

The motor mount is made in two parts: a motor base (you buy one at $7.98) and a pulley base (one for each tool at $9.87 from Graybill Industries, Inc., 2907 North Monroe, Spokane, Wash.). A pulley base with the correct-size pulley is installed in the regular motor-mounting position on each tool and connected with the V belt. The motor is bolted to the motor base and the "plug-in" coupling is mounted on its shaft. To shift the motor from one tool to another, you simply slide it off one pulley base and onto another. A spring latch automatically locks it in position and centers the clutch coupling in the drum. When the motor switch is turned on, weighted rubber segments in the coupling expand by centrifugal action to drive the clutch drum.

You save important money on shop motors by using the single latch-on motor. In a shop consisting of five power tools, the cost to drive them with one motor would be about $35 for the motor, $7.89 for one motor base and $49.35 for five pulley bases, bringing the total to $92.24. Individual motors to drive the five tools might cost up to $175.

Each pulley base has its own shaft bearings, reducing wear on the motor bearings. The motor can be stored in a cabinet, when not in use, to keep children from turning on any of the machines.

HANDLE ON MOTOR BASE makes moving it from tool to tool a one-hand operation. Each tool in the shop is equipped with a pulley base. The drive pulley and V belt remain undisturbed.



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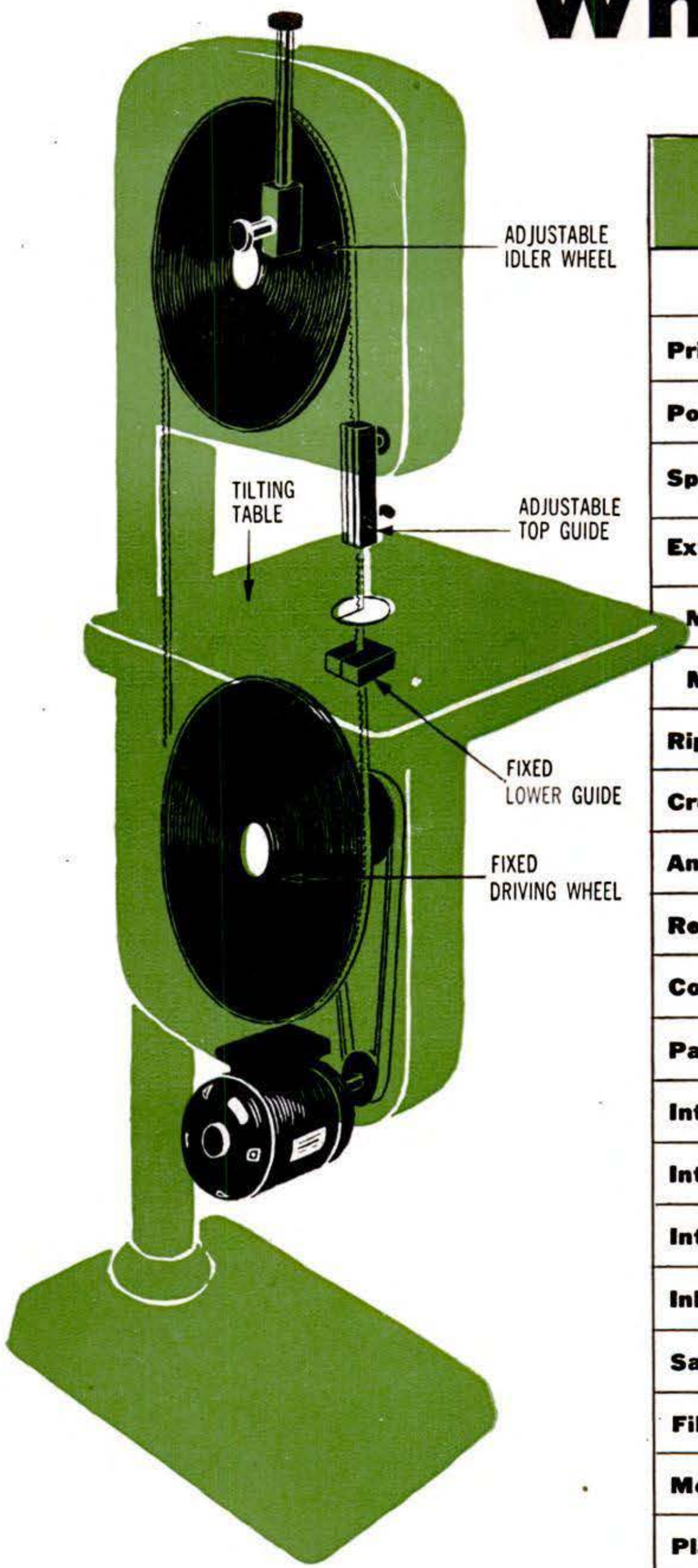
Bandsaw or Jigsaw? Which Should



BANDSAW ANATOMY: Bandsaws may have either two or three flangeless wheels over which a continuous blade travels. One wheel is adjustable to maintain blade tension. Guides above and below the exposed section of the blade resist pressure from stock being cut.

How They Stack Up

	BANDSAW	JIGSAW
Price range (average)	$50—$100	$20—$50
Power requirements	½—¾ hp.	¼—½ hp.
Space requirements	Bandsaws generally need more space	
Extras required	Both need stand, motor, pulley and belt	
Max. depth of cut (average)	6″	2″
Max. width of cut (average)	12″	18″
Ripping with guide?	yes	limited
Crosscutting with guide?	yes	limited
Angle sawing with table tilt?	yes	yes
Resawing?	yes	limited
Compound sawing?	yes	limited
Pad sawing?	yes	yes
Intricate irregular sawing?	no	yes
Internal sawing?	no	yes
Internal bevel sawing?	no	yes
Inlay work?	no	yes
Sanding?	limited *	yes
Filing?	no	yes
Metal sawing?	yes	yes
Plastics sawing?	yes	limited
Sawing in stock with unlimited face area?	no	yes **

*Only one make offers a sanding attachment
**On jigsaws equipped with removable upper arms

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You Buy?

By R. J. De Cristoforo

Versatile as both these power tools are, one may serve you better than the other. Here's how they compare

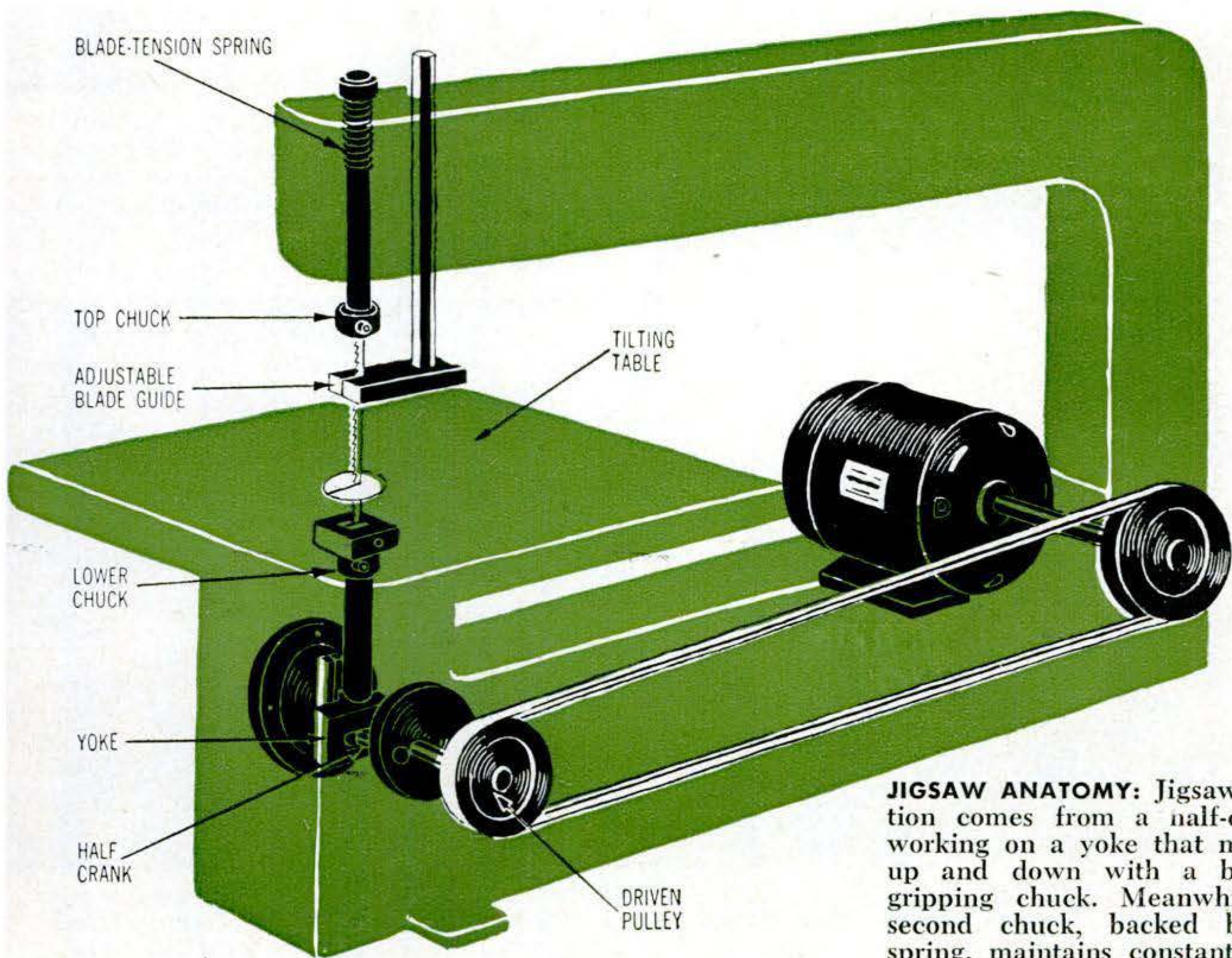
SO YOU'RE a spare-time woodworker with a problem. You own a table saw and it's one of the most useful tools in your shop. But there are times when you have irregular cutting to do. A circular saw is no help there. What you need, if you want to avoid a lot of manual labor, is either a bandsaw or a jigsaw. Say you can't afford both. Which one should you put your money on?

Don't let this puzzler throw you.

First, recognize the fact that while bandsaws and jigsaws have many features in common, each will do certain types of work either better than, or beyond the ability of, the other. Evaluate these advantages and limitations on the basis of your own particular needs (the check list on the facing page will help).

As versatile and enticing as both of these power tools are, you should have little trouble selecting the one that's better for you.

For specific examples of jigsaw and bandsaw pros and cons, see the pictures on the next four pages.



JIGSAW ANATOMY: Jigsaw motion comes from a half-crank working on a yoke that moves up and down with a blade-gripping chuck. Meanwhile a second chuck, backed by a spring, maintains constant tension at the other blade end.

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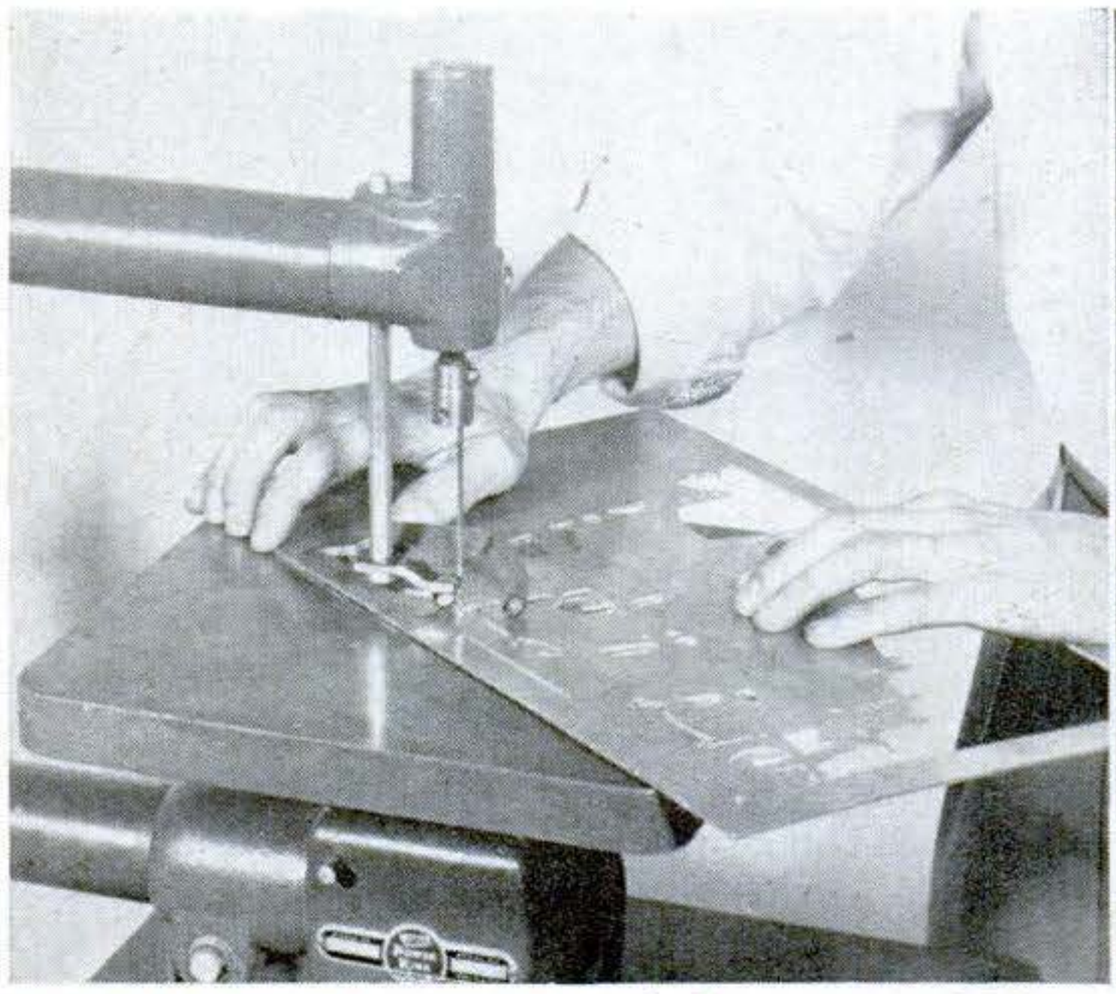
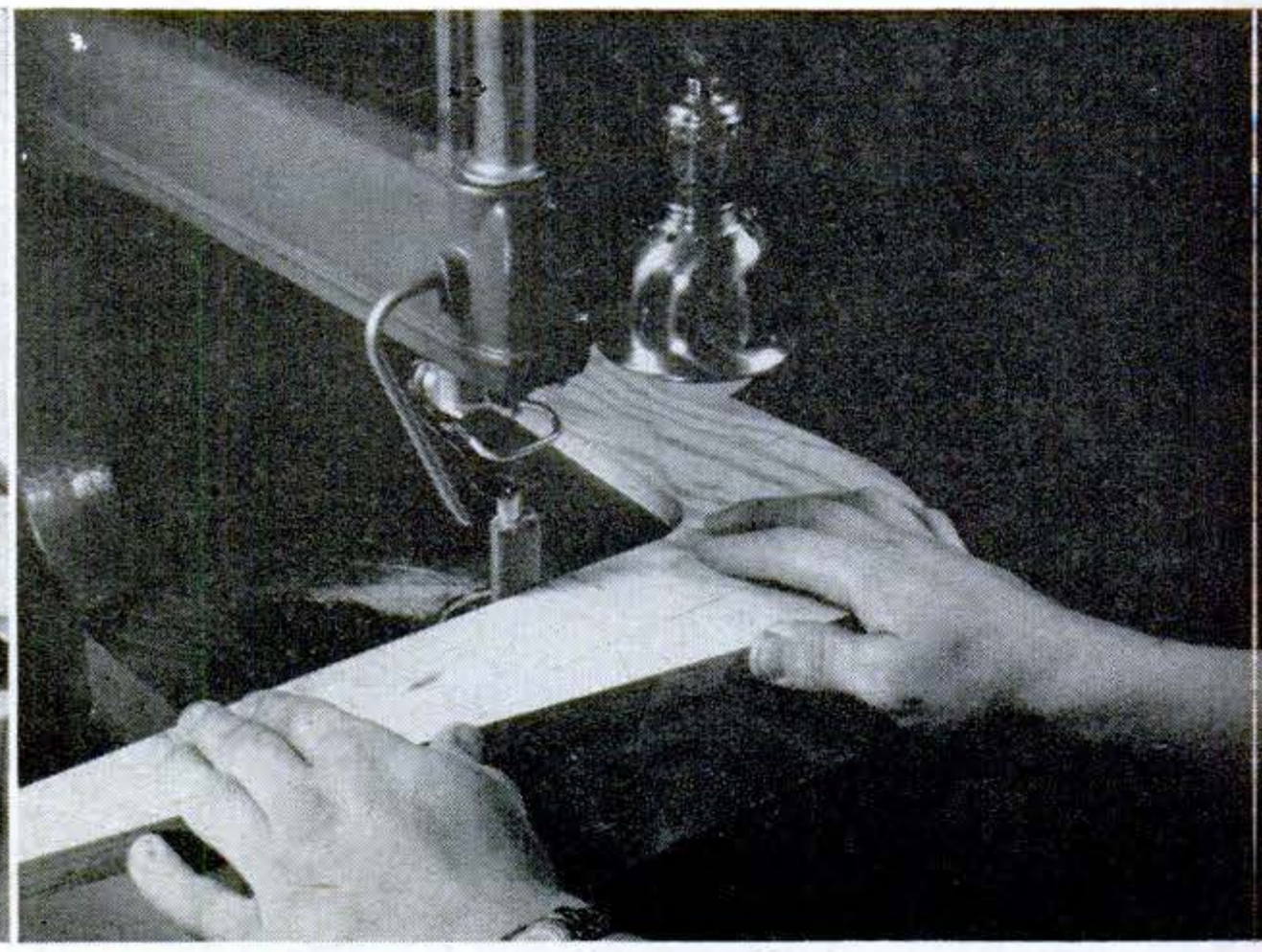
Here's where a jigsaw shines

HANDLING STOCK OF UNLIMITED FACE AREA: Most jigsaws have removable upper arms, eliminating throat-clearance problems. A heavy (saber) blade makes top chucking unnecessary. Care must be taken, of course, to prevent the unsupported blade end from flexing. But once you get the feel of the stock, and of the blade's response to the rate of feed, you can follow guide lines closely. If cuts do waver a bit, they can be trued with jigsaw sanding.



INTRICATE METAL CUTTING: Blades are available for cutting nonferrous and hard metals. Here again, you can do finer work with a jigsaw, and of course aren't limited to outside cuts.



SANDING: Gripping an abrasive sleeve, a jigsaw's half-round sanding-stick attachment can smooth both convex and concave edges. Only one make of bandsaw has a sanding attachment.

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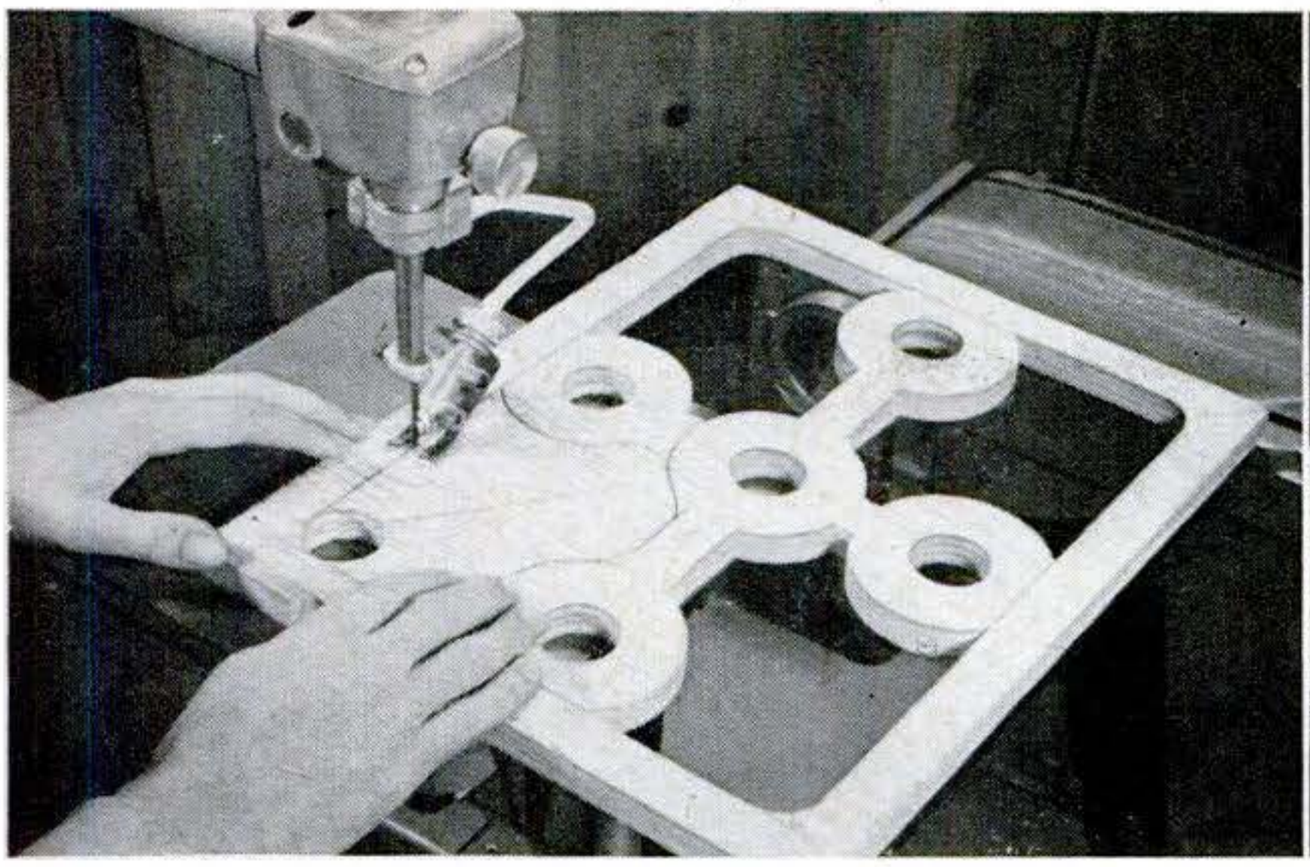
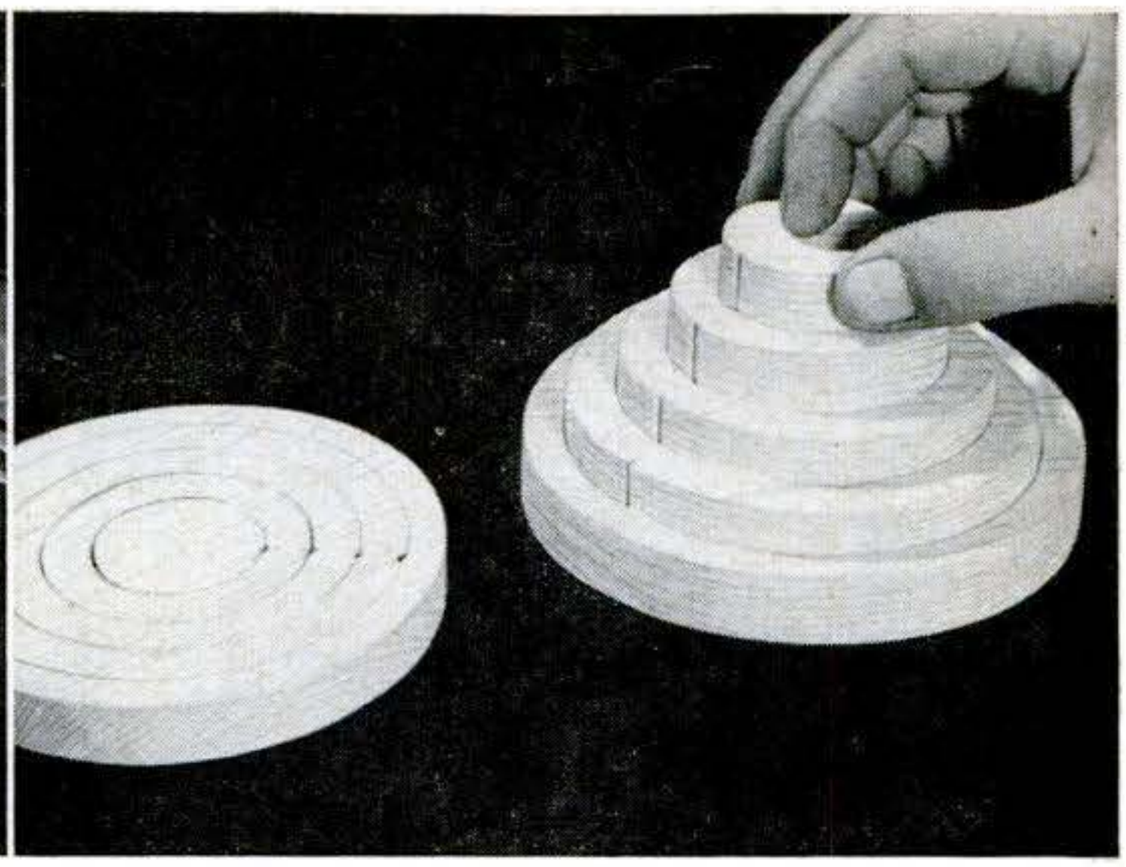
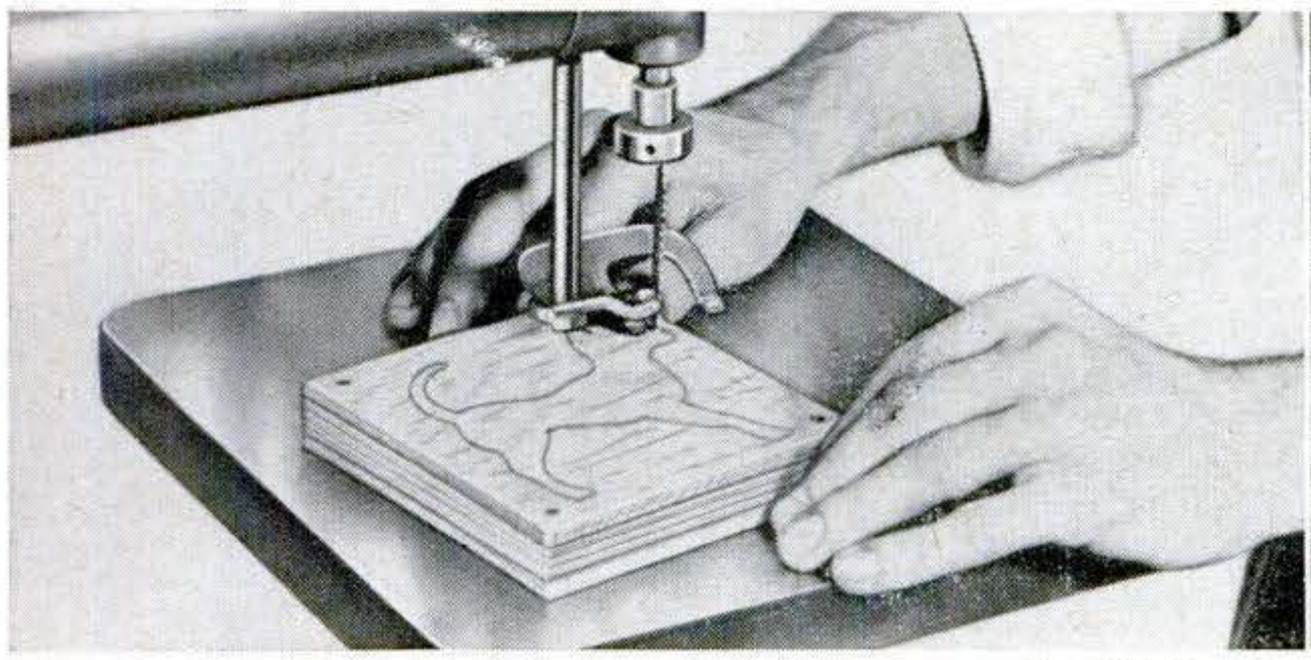
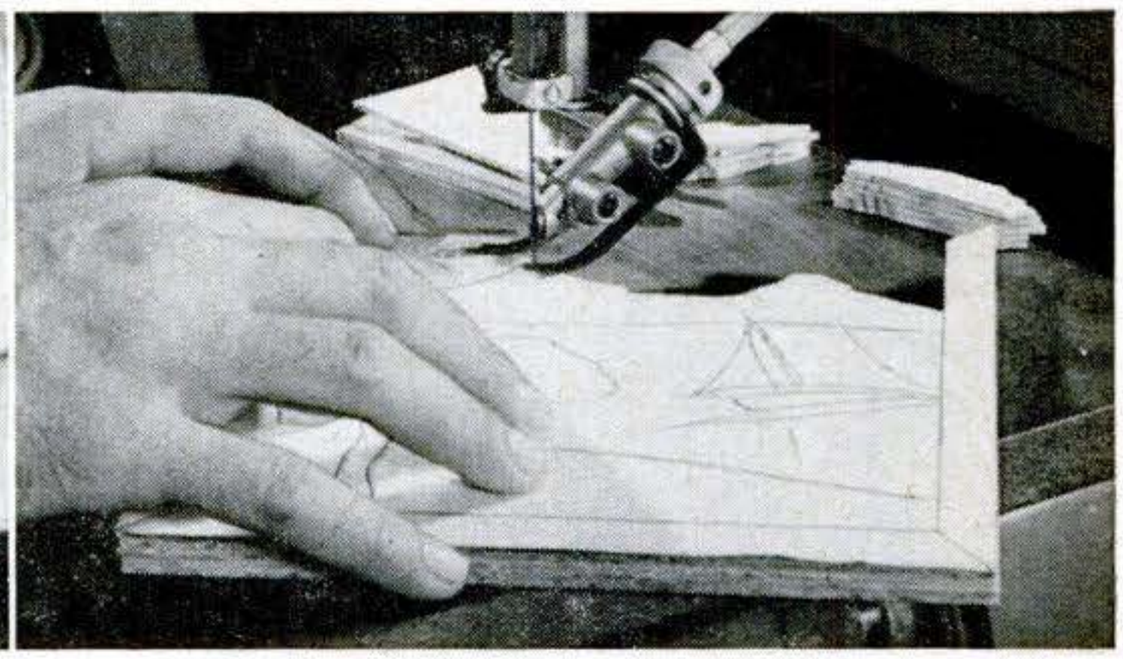


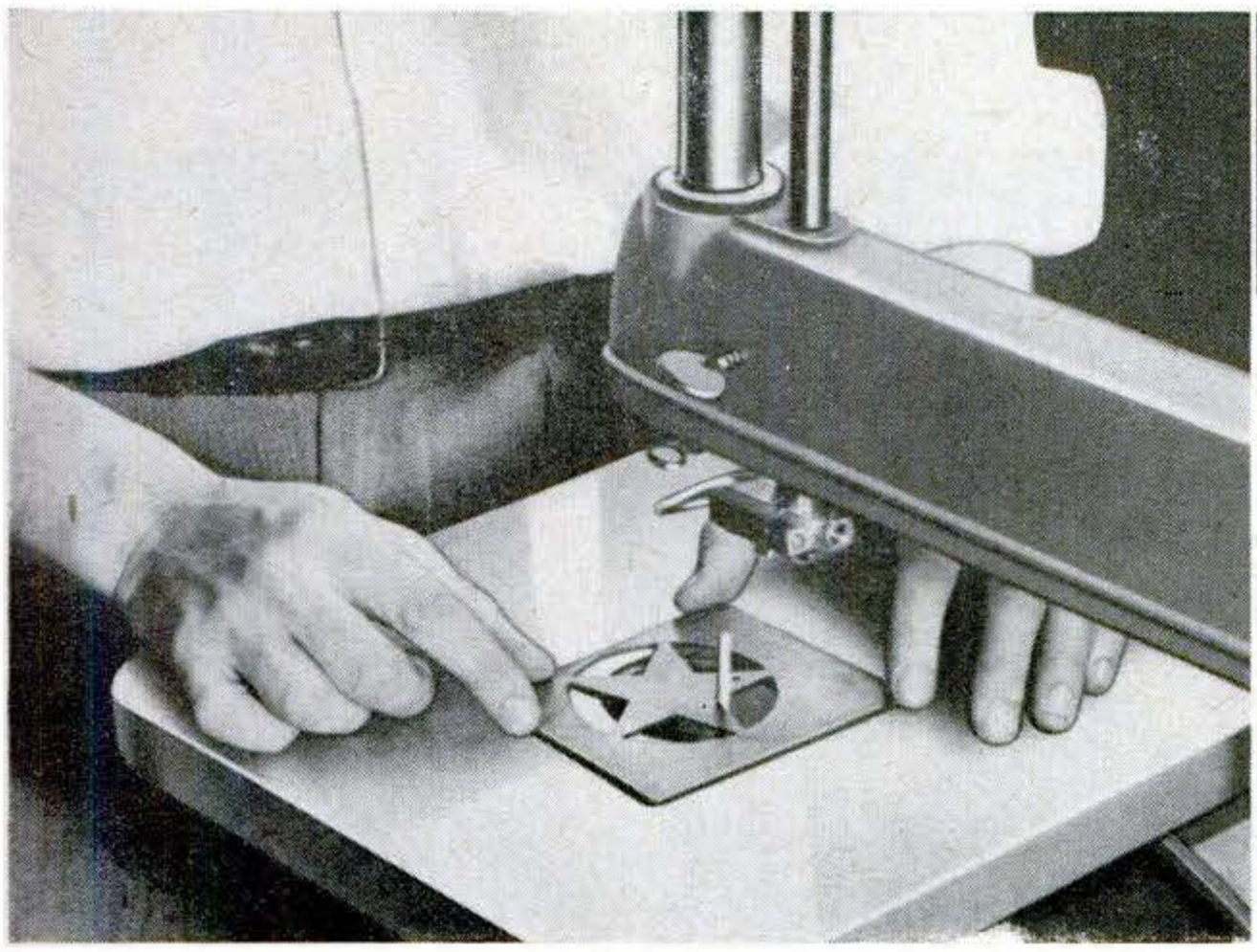


MAKING INTERIOR CUTS: Only a jigsaw can run off interior cuts like these. It's done by drilling a starting hole and slipping the stock over the retracted blade before its upper end is fastened in the top chuck. An old woodworking trick makes use of this feature. With the jigsaw table tilted from one to 10 degrees, concentric rings are sawed in a disk. The bevels hold them together when the center section is raised as shown. Glued in this position, they form a thick blank for bowl-turning. Later, wood putty is used to fill in the starting holes.

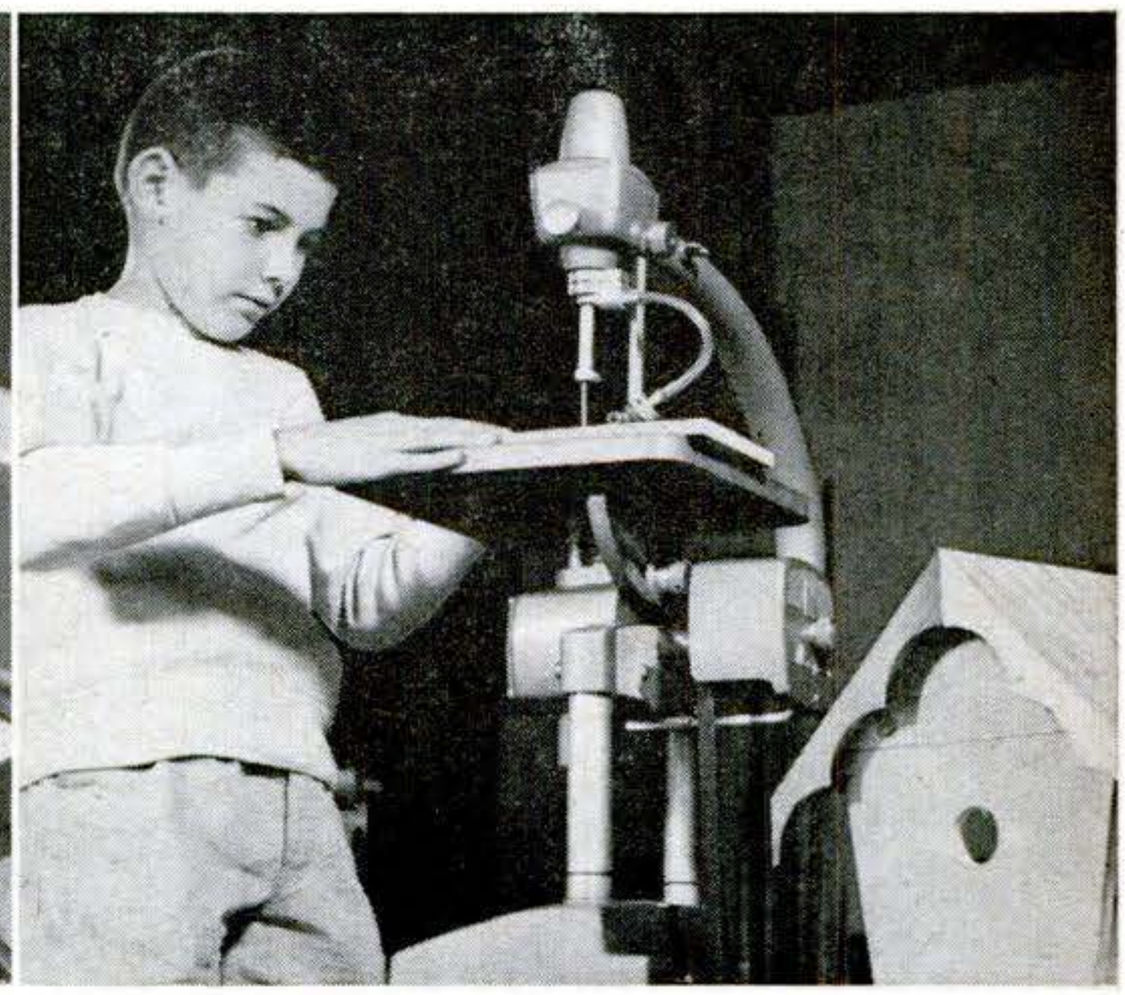




PRODUCING PRECISE, FINE WORK: Small jigsaw blades can turn on a smaller radius than a bandsaw's, remove less stock, and minimize tooth tear on the undersurface of the work. At left above, multiple cutouts are made in a stack of paper sheets sandwiched between two blocks. At right, another multiple operation is shown: Parts for five identical inlaid-wood pictures are cut from a like number of veneer sheets. The pieces are interchangeable.



FILING: Here's another jigsaw specialty. Clamped in the lower chuck, square, triangular, round or half-round files do a fast job of shaping metal parts and smoothing burred edges.



SUMMING IT UP: A jigsaw has less capacity but more versatility than a bandsaw. It's also much safer—a good tool to help you introduce anyone to woodworking. [*Please turn the page*]

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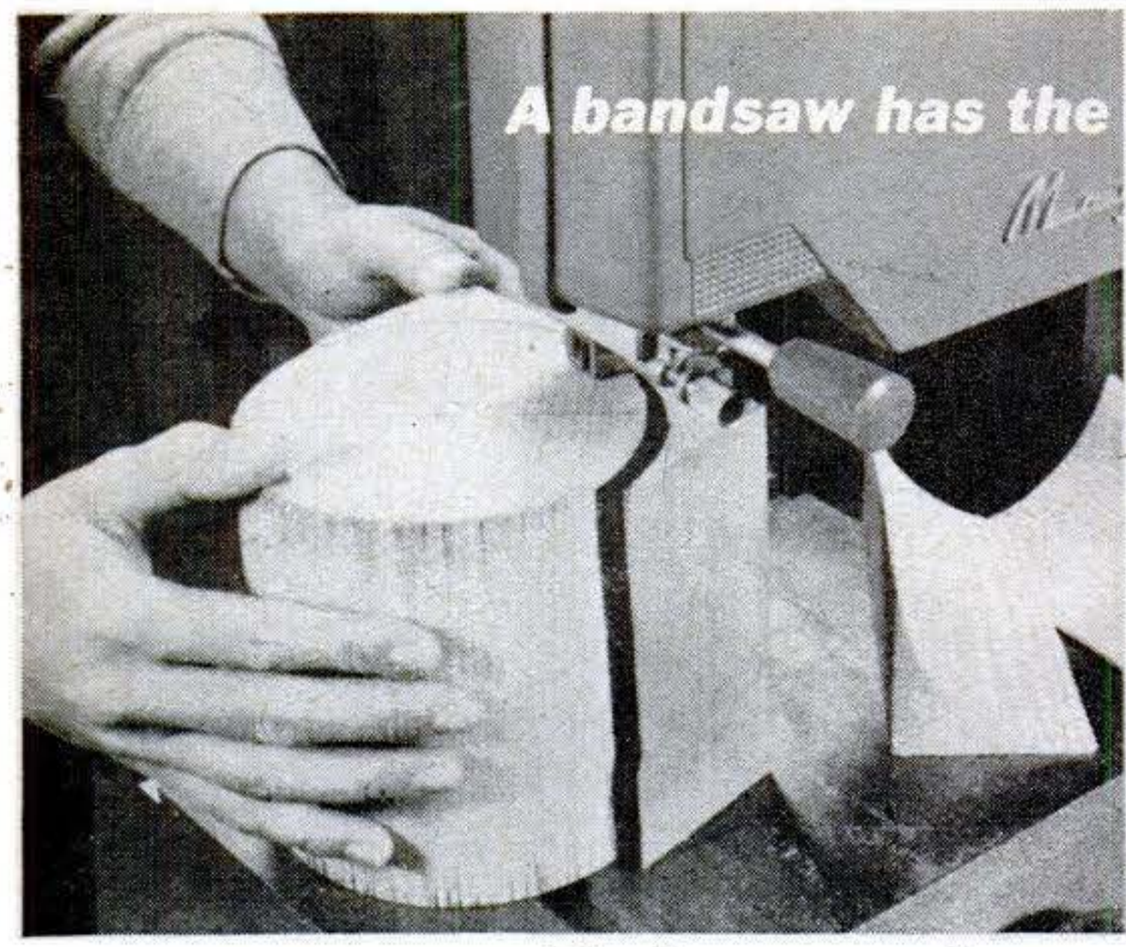
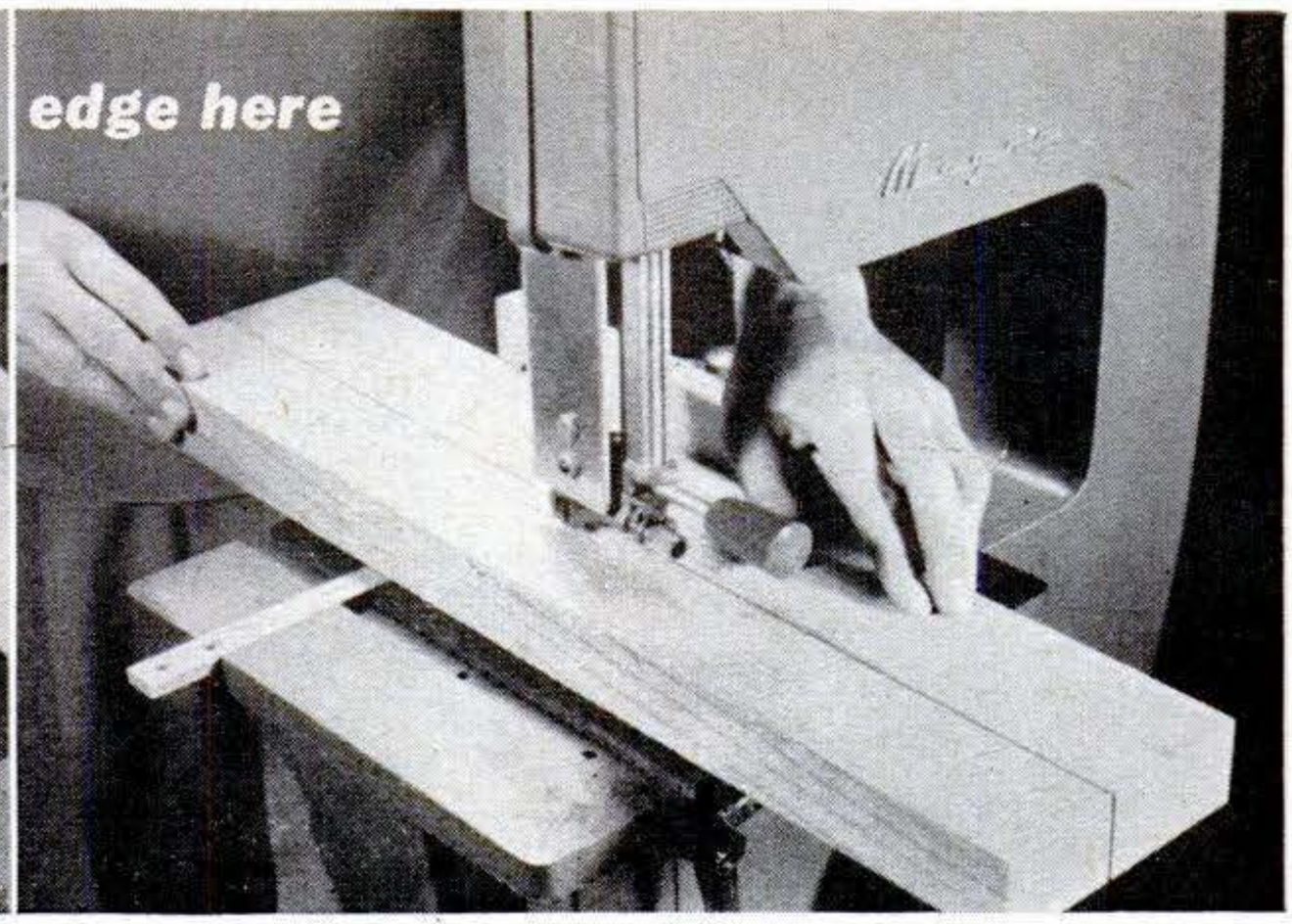
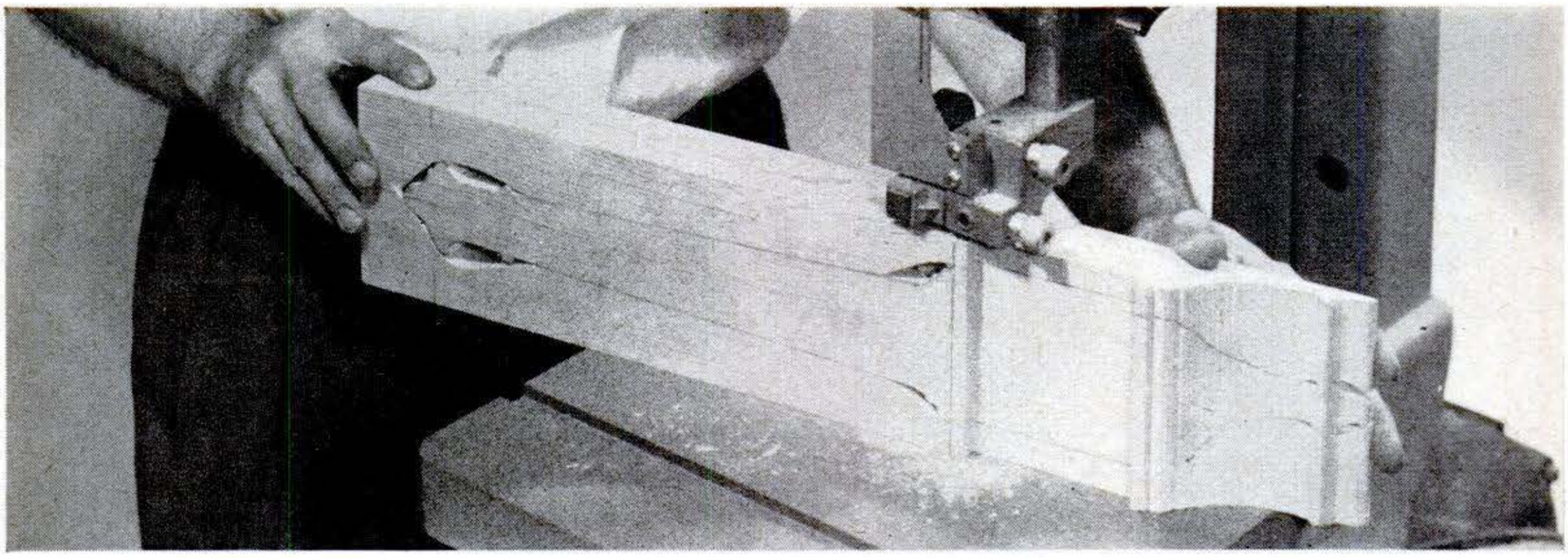


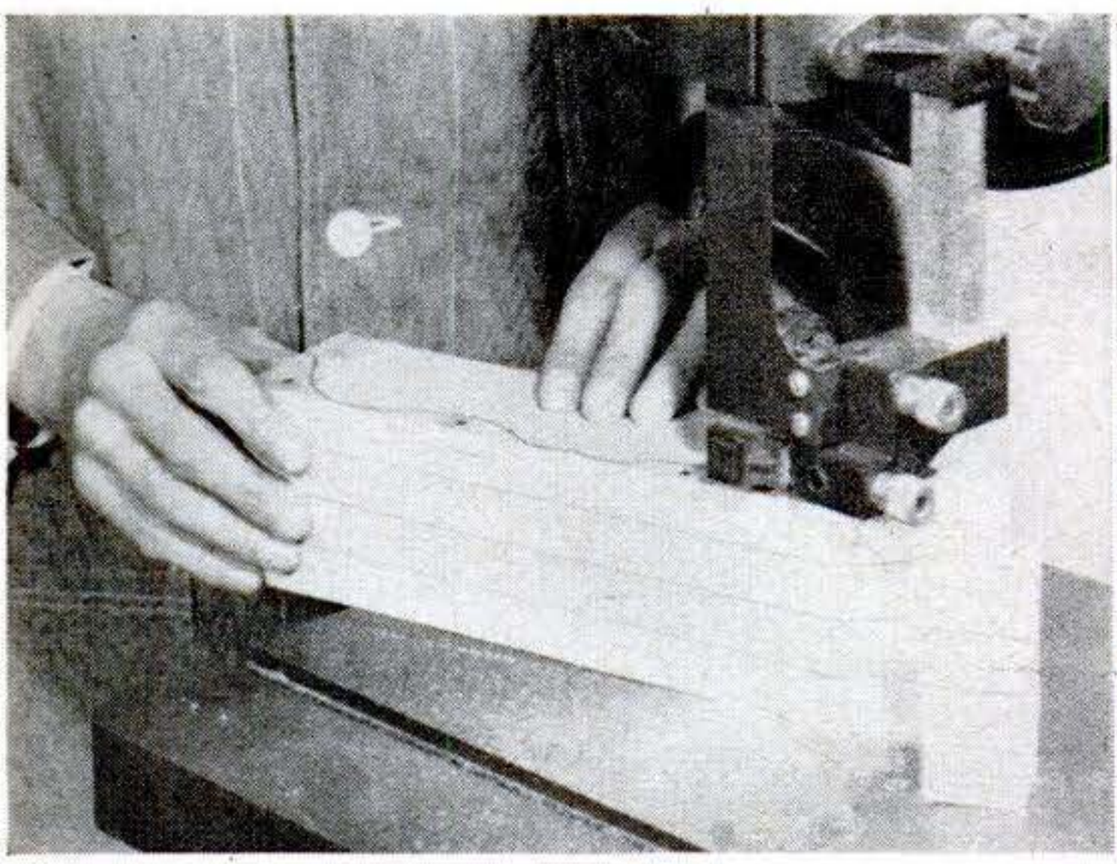


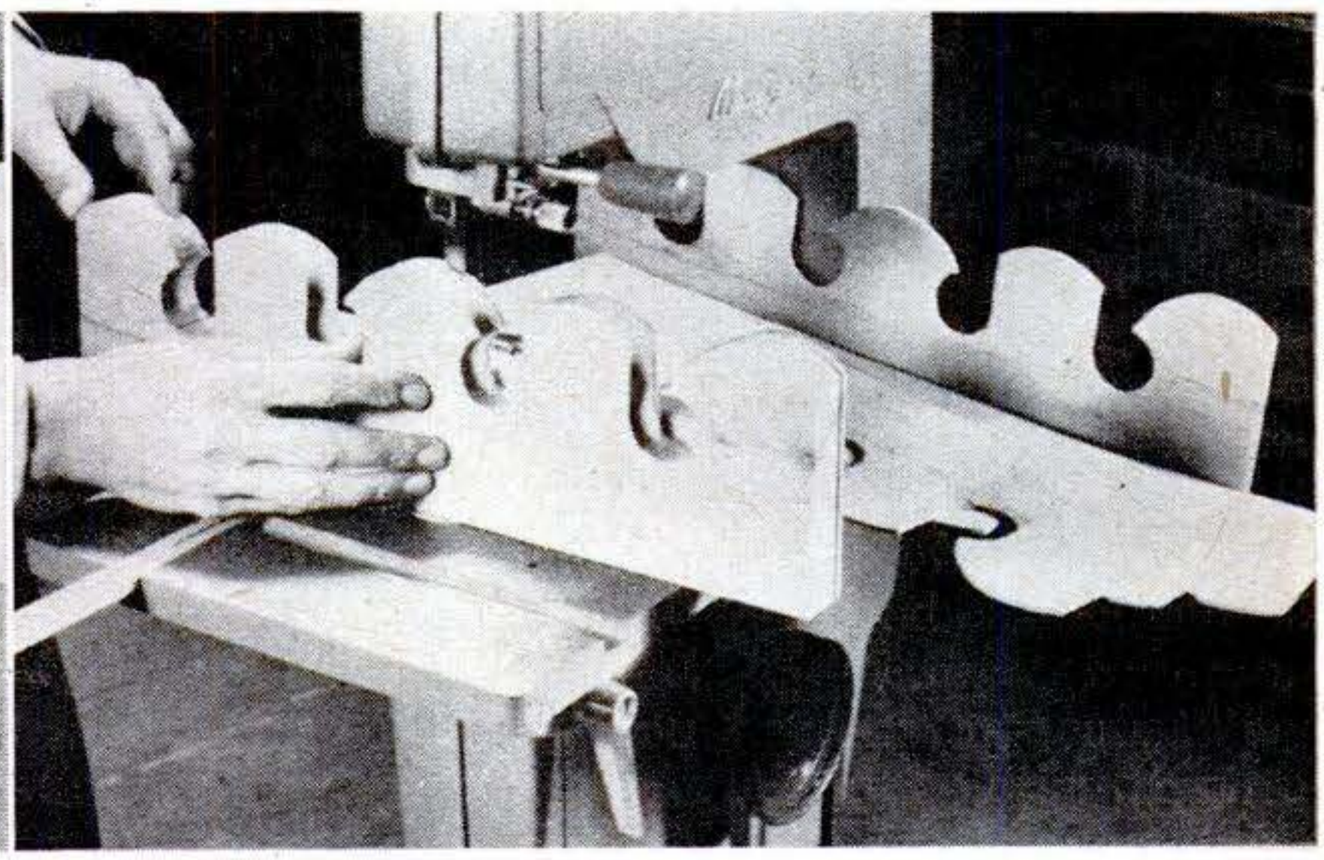
CUTTING THICK STOCK: The long, exposed section of a bandsaw blade whizzes through wood from three to four times as thick as you can cut with a jigsaw. Here, a hefty 6″ block is preshaped for turning on a lathe.

MAKING STRAIGHT CUTS: With a rip fence, or a miter gauge set in one of its table slots, a bandsaw runs off straight cuts as accurately as, and faster than, a circular saw. Bandsaws are also easier to set up for taper cuts.



HEAVY COMPOUND SAWING: In this operation, waste from contour cuts through one plane of the stock is nailed back in place. Then, with the stock turned 90 degrees, a second set of cuts is made. You can do compound sawing on a jigsaw, too, but only to form small parts.





MASS-PRODUCING PARTS: Because a bandsaw can make both straight and irregular cuts through thick stock, it offers the woodworker a choice of two methods for mass-producing parts. In *pad sawing* (above left), a number of blanks are temporarily nailed together and contour-sawed. In *resawing* (above right), a thick block is contour-sawed first, then sliced into parts.

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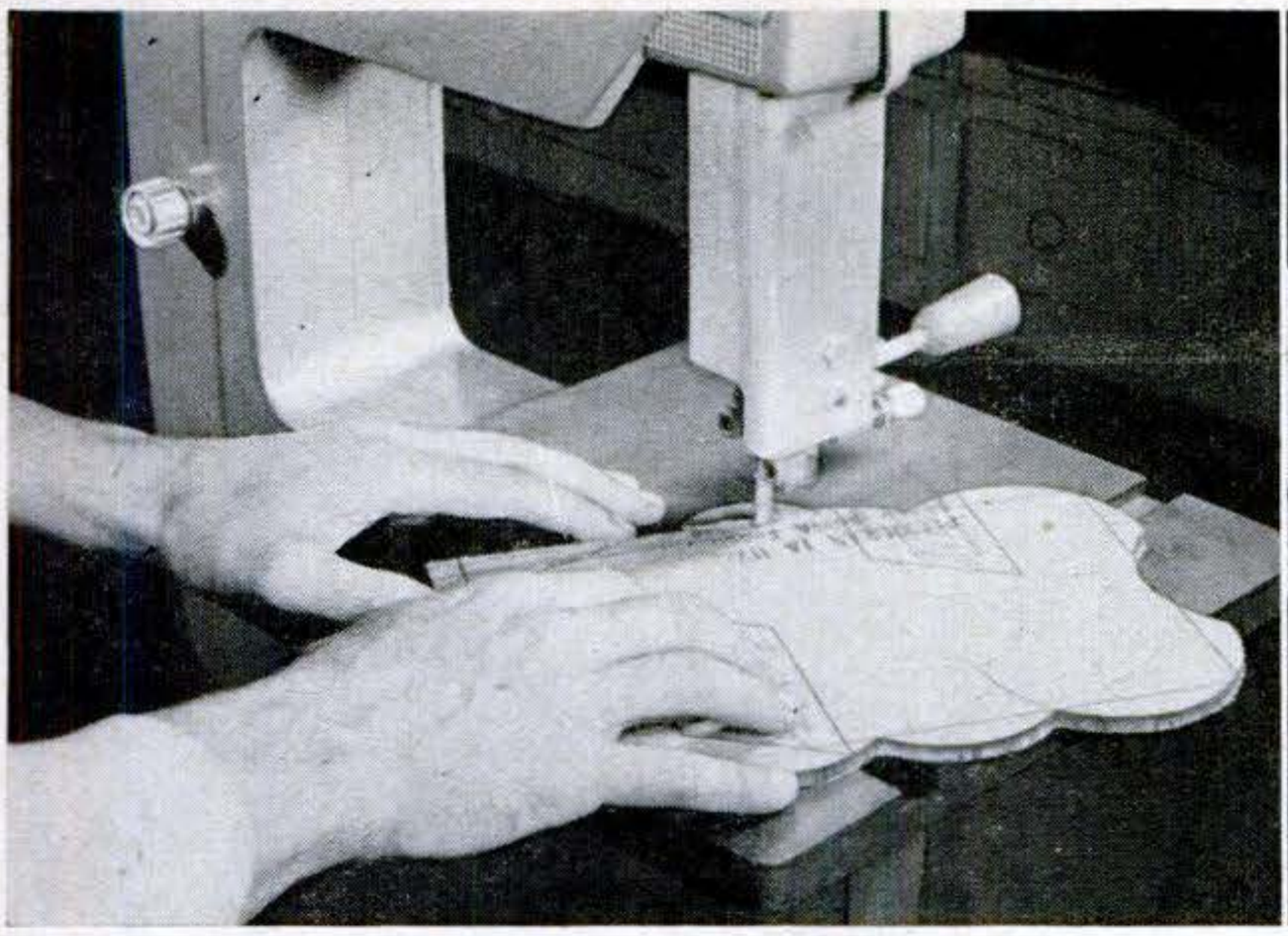
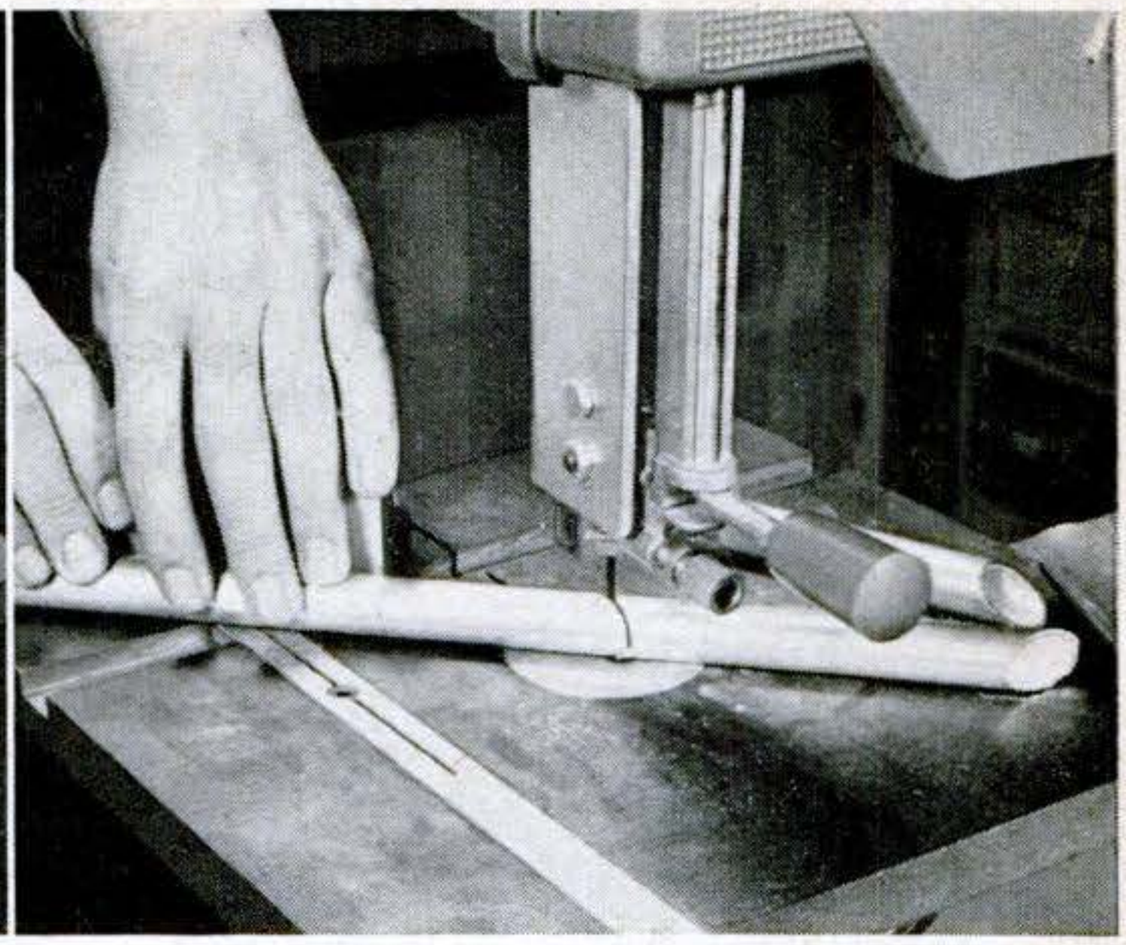
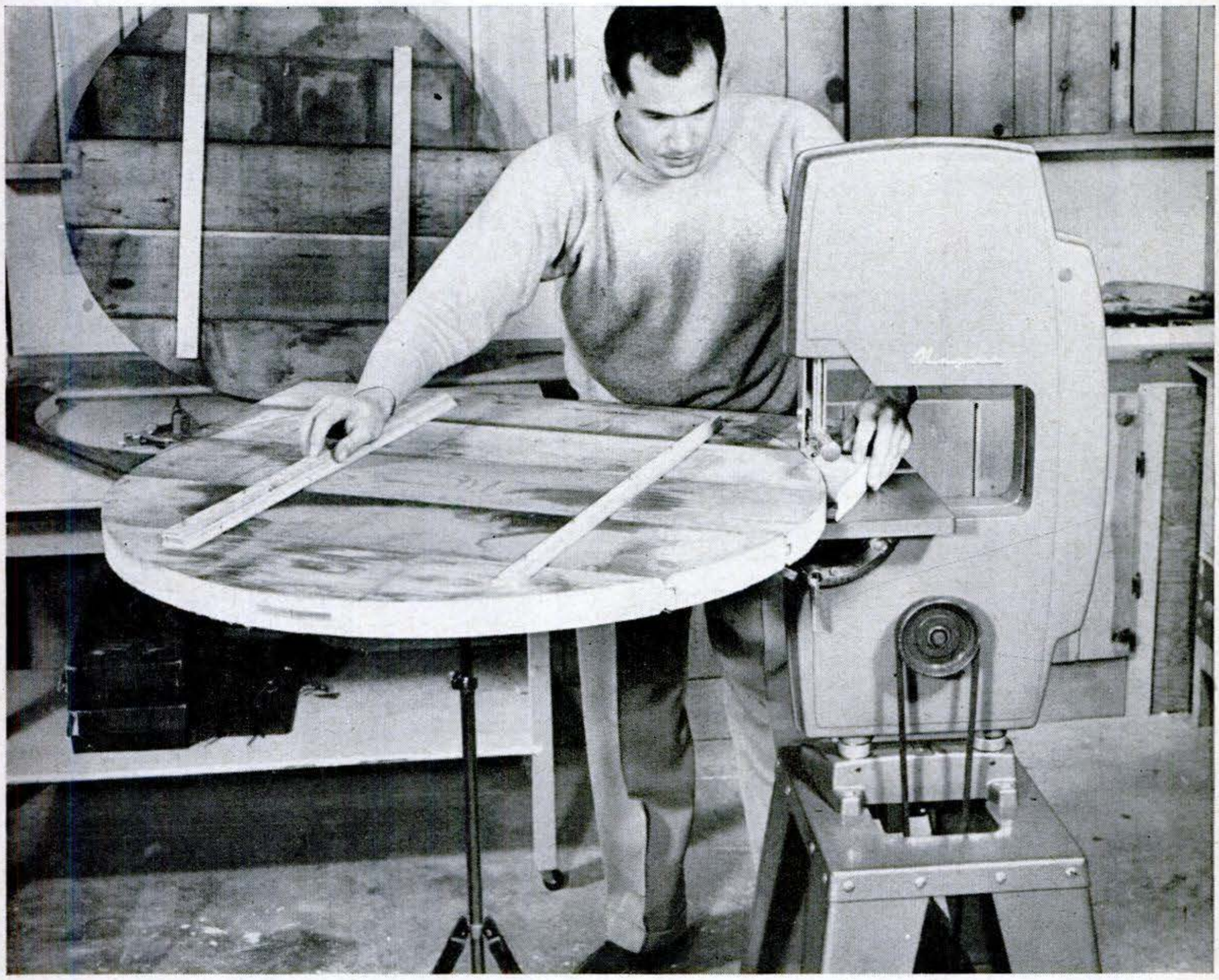


SAWING PLASTICS: A bandsaw blade's one-directional motion throws chips away and develops little heat, while a jigsaw blade returns chips to the kerf and often generates enough heat to "weld" them back in place.



CUTTING MEDIUM-TO-HEAVY METAL: You can buy special blades that will saw both nonferrous metals and wood. Hard-metal cutting blades are also available. Used with a speed-reduction unit, they'll handle almost any job.



SUMMING IT UP: A bandsaw is a high-capacity performer, at its best on the big jobs—turning out heavy cabinetwork, making lawn furniture, boatbuilding, etc. It is also made to order for mass-producing large parts. Among *professional* woodworkers, bandsaw owners outnumber those having jigsaws. If you go in for ambitious projects it's the tool for you. END

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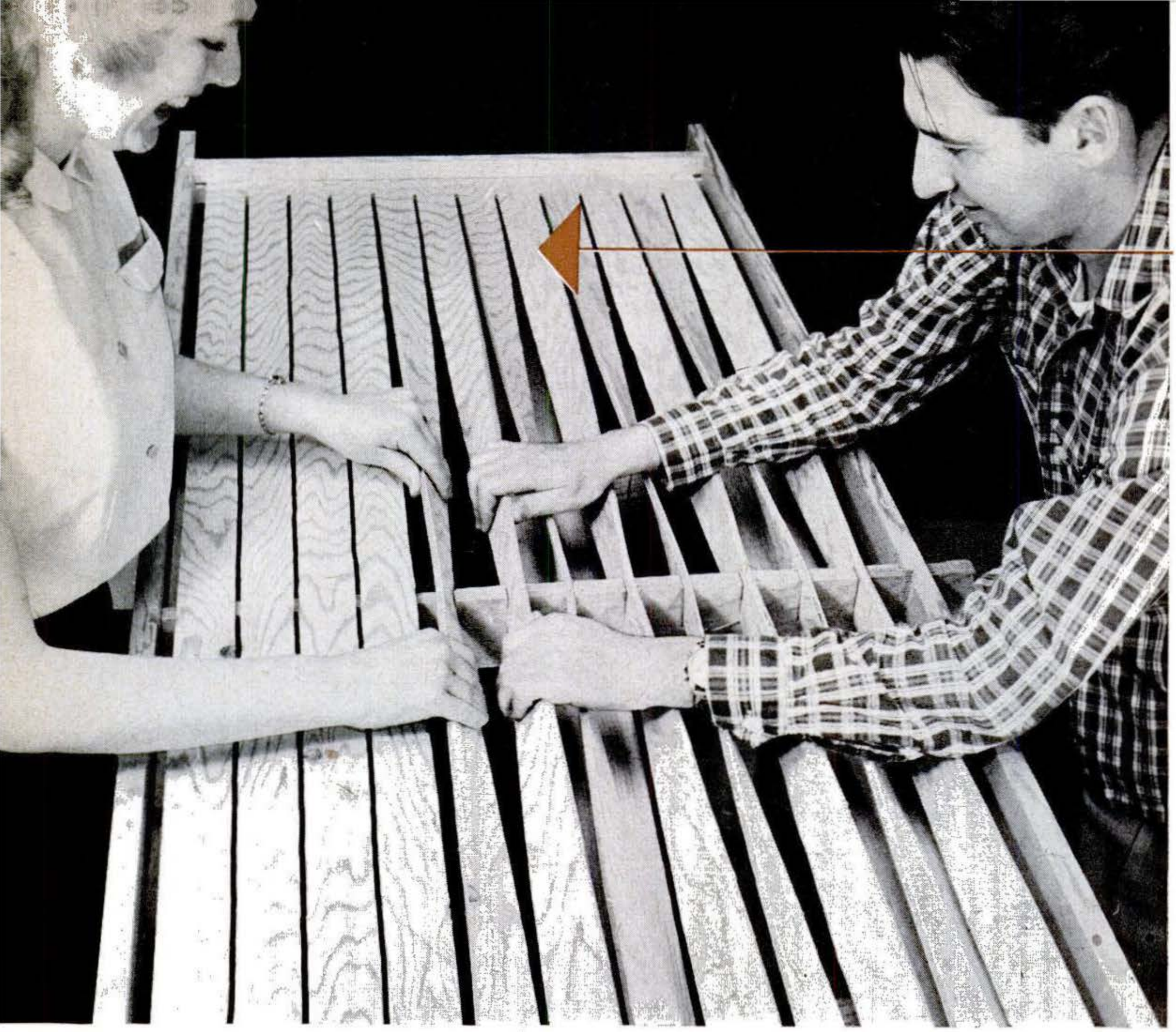

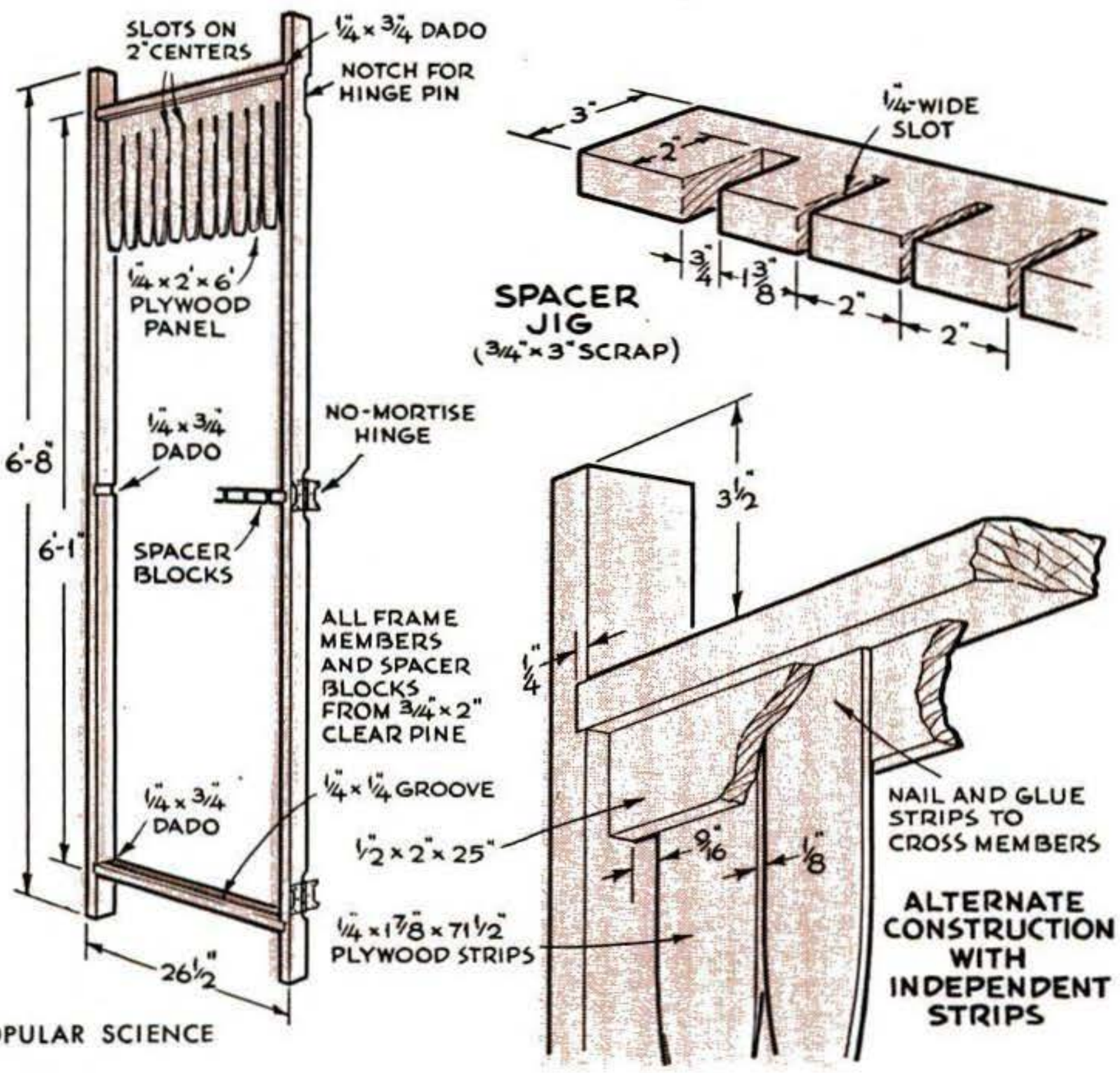

What to buy

You'll need three 2'-by-6' sheets of 1/4" plywood, three 20' lengths of 3/4"-by-2" (actual, *not* nominal size) clear pine, and six 3" no-mortise hinges. Also, some 6-penny finishing nails, a can of plastic-resin glue, and approximately two quarts of enamel, lacquer or clear varnish.

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Here's a slick new idea in home furnishings:

Twisting Plywood for a Folding Screen

By Paul Corey

YOU can bend and twist strips of thin fir plywood into all kinds of shapes. The handsome, homemade screen that you see below takes advantage of this flexibility. The materials to build it cost about $12. You can use it as a room divider or as a backdrop for modern furniture.

The job in brief

The screen consists of three panels of ¼″ plywood framed in ¾″-by-2″ wood. Each panel is cut lengthwise into strips 2″ wide, the cuts terminating 2″ from the panel ends. Each strip is then twisted 90 degrees at midpoint and glued in place with wood retaining blocks.

Tools you need

Slits were cut for this screen with a Porter Cable Routo-Jig, but you can use any power router with a ⅛″ bit. Or use independent plywood strips sandwiched between framing members, and you can do the whole job with hand tools. (In this case, add two 14′ lengths of ½″-by-2″ pine, and some 2-penny nails to your shopping list.)

Either way, the hand tools needed are hammer, screwdriver, handsaw, chisel and two C clamps.

Now see the next page for the details of how it was built

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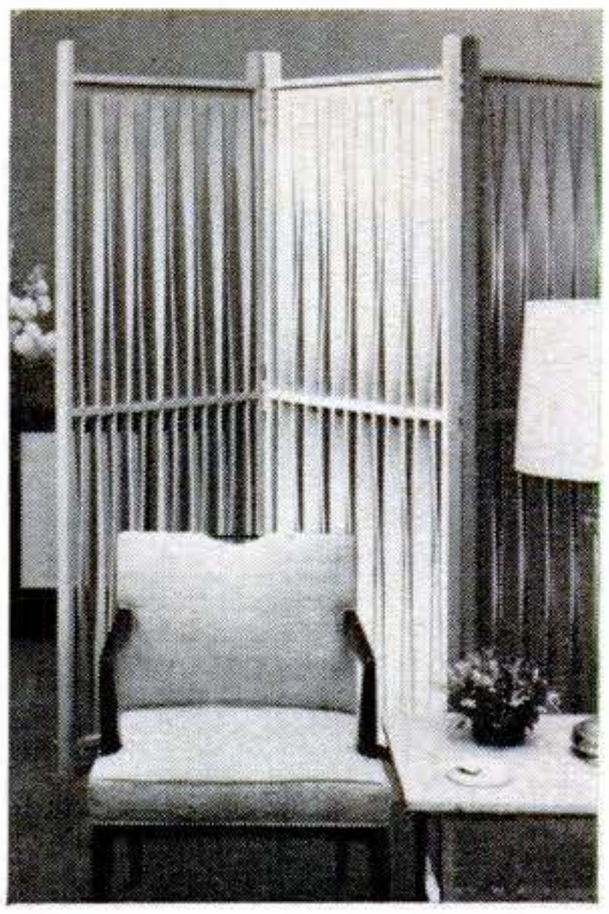


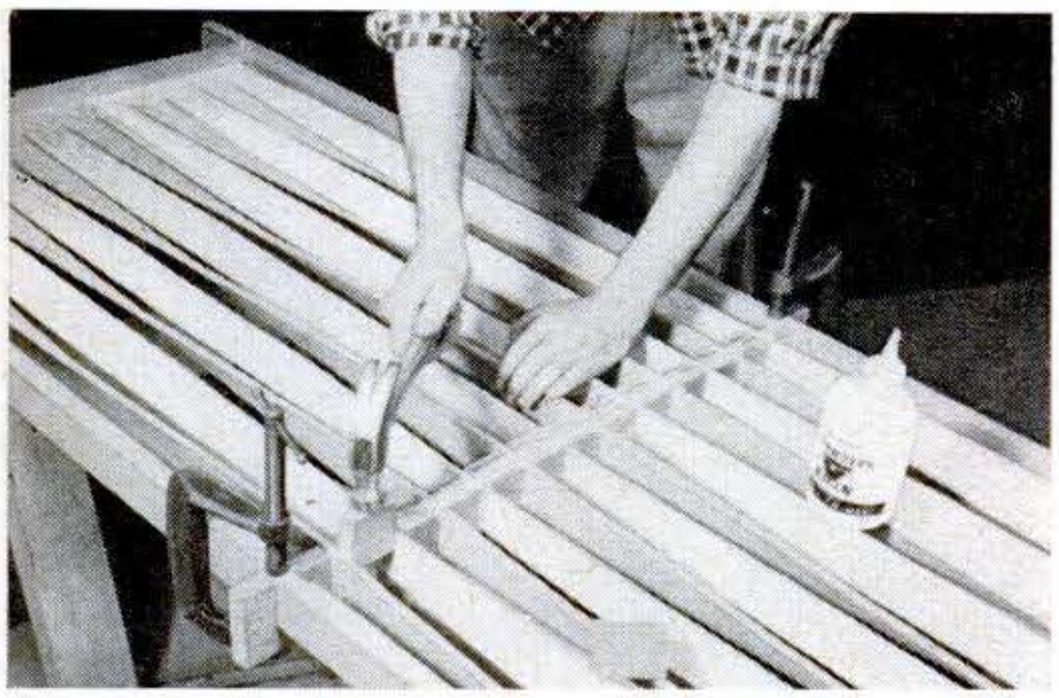
Here it sets off a modern chair. More building details for the screen of twisted plywood

START by cutting the parts for the frames. Each 20′ length of ¾″-by-2″ pine will give you two 6′ 8″ uprights and two 25½″ cross members, with enough material left over for 11 1¾″-long spacer blocks and two 1¾″-long end spacer blocks.

If you are using a power router, run a ¼″-by-¼″ groove the length of each cross member along the center line of one of its broad faces. If this is a hand-tool job, cut 12 supplementary framing members, each 25″ long, from two 14′ lengths of ½″-by-2″ pine. With these, and independent plywood strips, no grooves are needed.

Next, cut three dadoes across one broad face of each upright. (Use a saw and chisel if you don't have a power router.) All dadoes are ¾″ wide and ¼″ deep. One is located at the exact center of each upright; the others are cut 3½″ in from the top and bottom.

Cutting the slits. If you use a power router to slice through the 2′-by-6′ panel, apply a shoe or guide attachment and slide it along a straightedge clamped to the panel. Cut the slits at 2″ centers, working to stop marks 2″ in from each panel end.



A SPACING JIG holds the twisted strips firmly in place while permanent retaining blocks are driven home. Eleven 1¾″-long spacer blocks hold the strips at 2″ centers, and two 1⅜″-long blocks go into dadoes at the ends.

If you're doing the work by hand, or with a power saw, cut 12 1⅞″-wide-by-71½″-long plywood strips for each screen section and glue and nail their ends between the cross-frame members, as shown in the detail drawing. Drive the nails in from both sides of the assembly, countersinking them and filling the holes with wood putty.

Putting the sections together. To assemble screen sections built up from strips, simply apply glue and nail the uprights to the three-piece cross members. Or, if you're using router-slotted panels, insert their top and bottom edges in the grooves of the single cross members before applying the uprights.

While the glue is drying, make a spacing jig from a piece of ¾″ scrap lumber at least 3″ wide and 30″ long. Cut two ¾″-wide-by-2″-deep slots in this jig, 25″ apart. Between these slots cut 12 more, each ¼″ wide by 2″ deep. Space these as shown in the jig diagram.

Place the jig on edge under one of the screen sections, just above or below the center dadoes in the frame uprights. Insert the uprights in the ¾″ jig slots. Then, starting at one side, give the first panel strip a 90-degree twist, and slip it into the corresponding ¼″ jig slot. Continue across the panel, twisting the strips in alternate directions.

After all strips are in place, apply glue liberally to the ends of the spacing blocks that will hold the alignment permanently. Also apply glue to contacting strip areas. Drive the blocks home with a hammer. True them up and, after covering both sides of the resulting crossbar with masking tape, clamp the line of blocks together between two stout strips of wood. Then remove the spacing jig and repeat the operation with the other two panels.

Finishing. After the glue sets, sand the blocks flush with the strips, smooth all strip edges and round the corners at the ends of the upright framing members slightly. Cut notches for the pins of the no-mortise hinges, and fasten the three screen sections together, hinging the outer sections in opposite directions for compact folding. Finally, apply two coats of paint, lacquer or clear varnish. END

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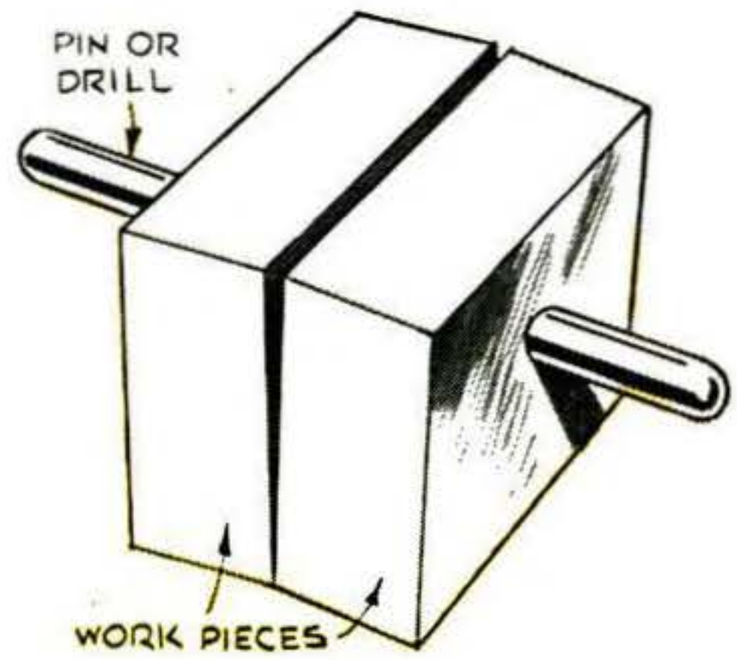
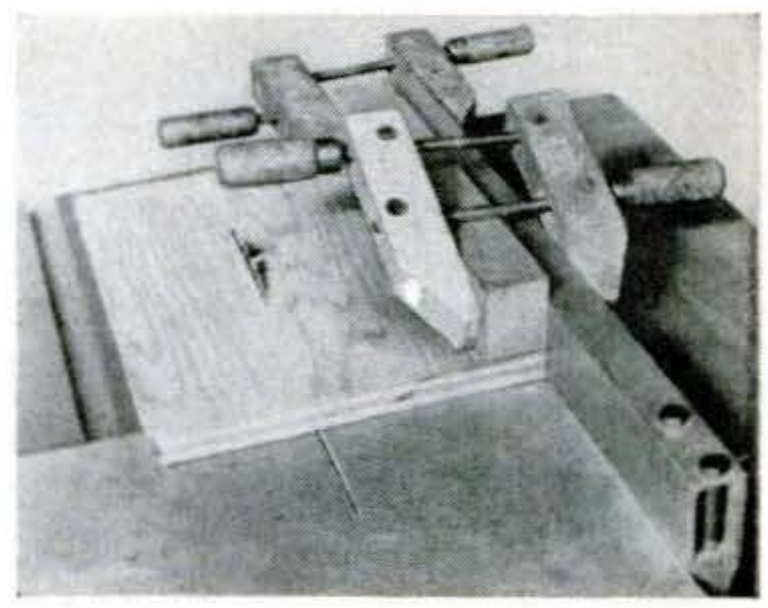
The POPULAR SCIENCE Shop Notebook

Check the accuracy of holes drilled 90 degrees to the work surface of production parts this way: Place two parts face to face on a piece of rod that fits snugly into or through the holes. If the holes are truly perpendicular no light will show when you sight between the parts while rotating one against the other.—*Frank La Saracina, New York City.*

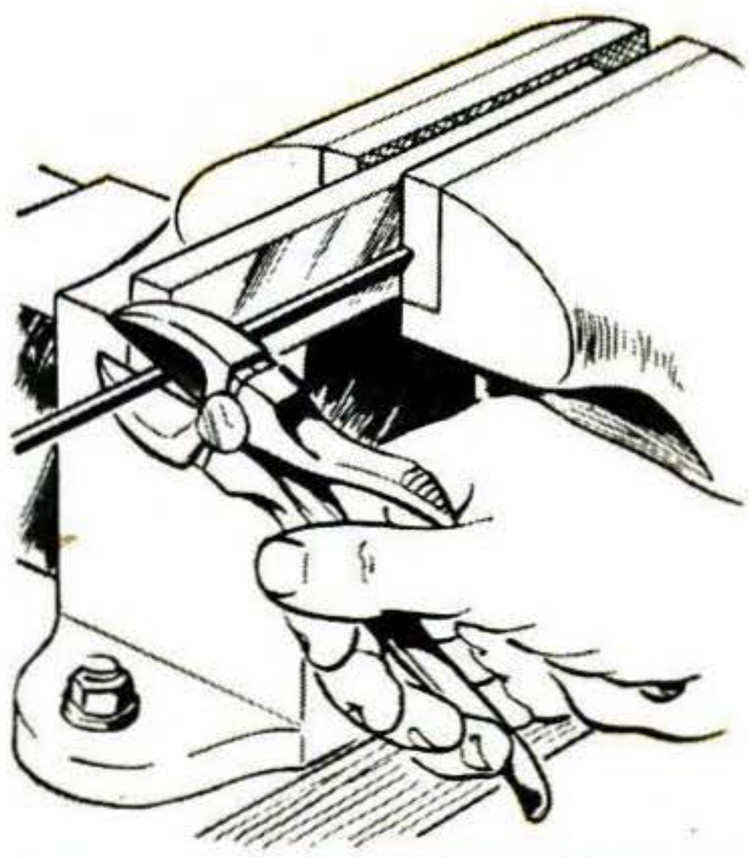


A hold-down made from a square piece of ¾″ plywood screwed to a length of two-by-two will prevent saw-wrecking vibrations when cutting sheets of nonferrous metals with a table saw. Clamp it to the fence with just enough clearance beneath for the metal to slip through. Adjust the fence for the cut; start the motor and raise the saw to make a slot in the plywood. With this setup, you can run off a clean, chatter-free cut.—*Henry J. Gilbert, Tulsa, Okla.*



To check the squareness of welded work, grind the outer corner off an old steel try square. With the corner removed, the square can be brought up to the metal surfaces without interference from the bead.

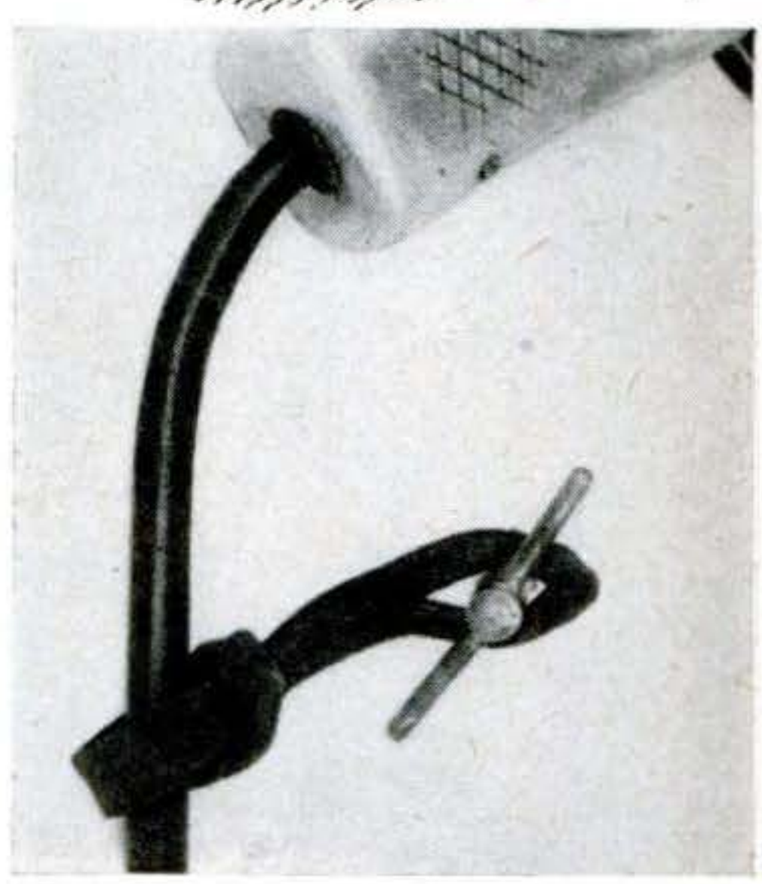
Cutting wire or thin rod to identical short lengths can be done accurately by using your vise and a strip of steel as a jig. Clamp the strip so it protrudes the required length from the side of the vise. Butt the end of the stock against the jaw (right), and clip off sections with cutting pliers held flat against the strip.—*Federico Strasser, Santiago, Chile.*



Corroded screws can be loosened in wood or metal by applying heat to their heads to expand the shanks. Use a well-heated soldering iron. If the tip is removable, reverse it so that the flat end instead of the point can be touched to the screwhead.

Cleaning concrete shop floors is easier if you tape a garden hose to a long-handled scrubbing brush. This will keep a steady stream of water in front of the brush as it is pushed across the floor to the drain.

A handy chuck-key retainer for a portable electric drill can be quickly made by cutting a ¾″-long slit near each end of a scrap of leather strap. Loop one end of the strap over the electric cord of the drill, and then draw it through the slit in the opposite end to a snug fit. Slip the key's bevel-toothed end through the other slit. This way the key will still be free to turn in the leather retainer strap whenever you want to use it. —*H. J. Gerber, Stillwater, Okla.*



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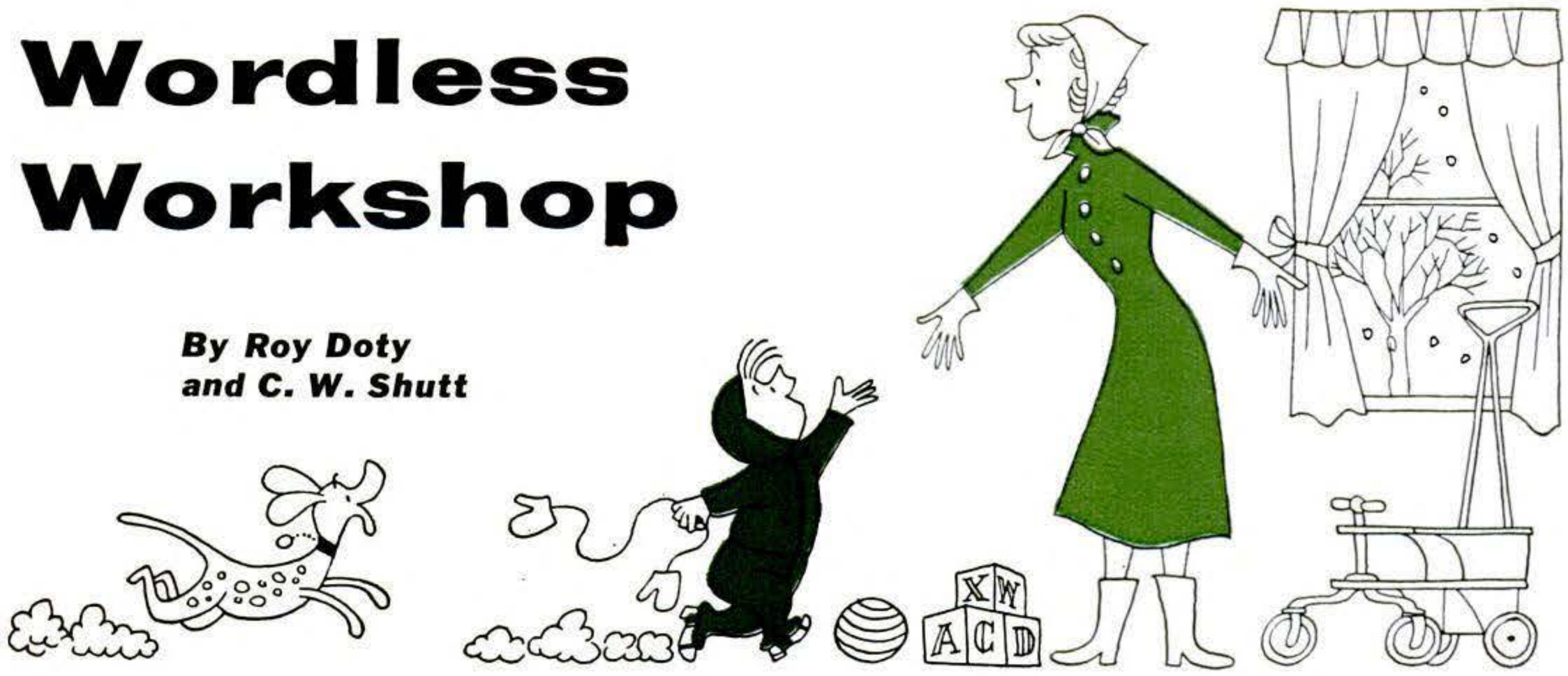
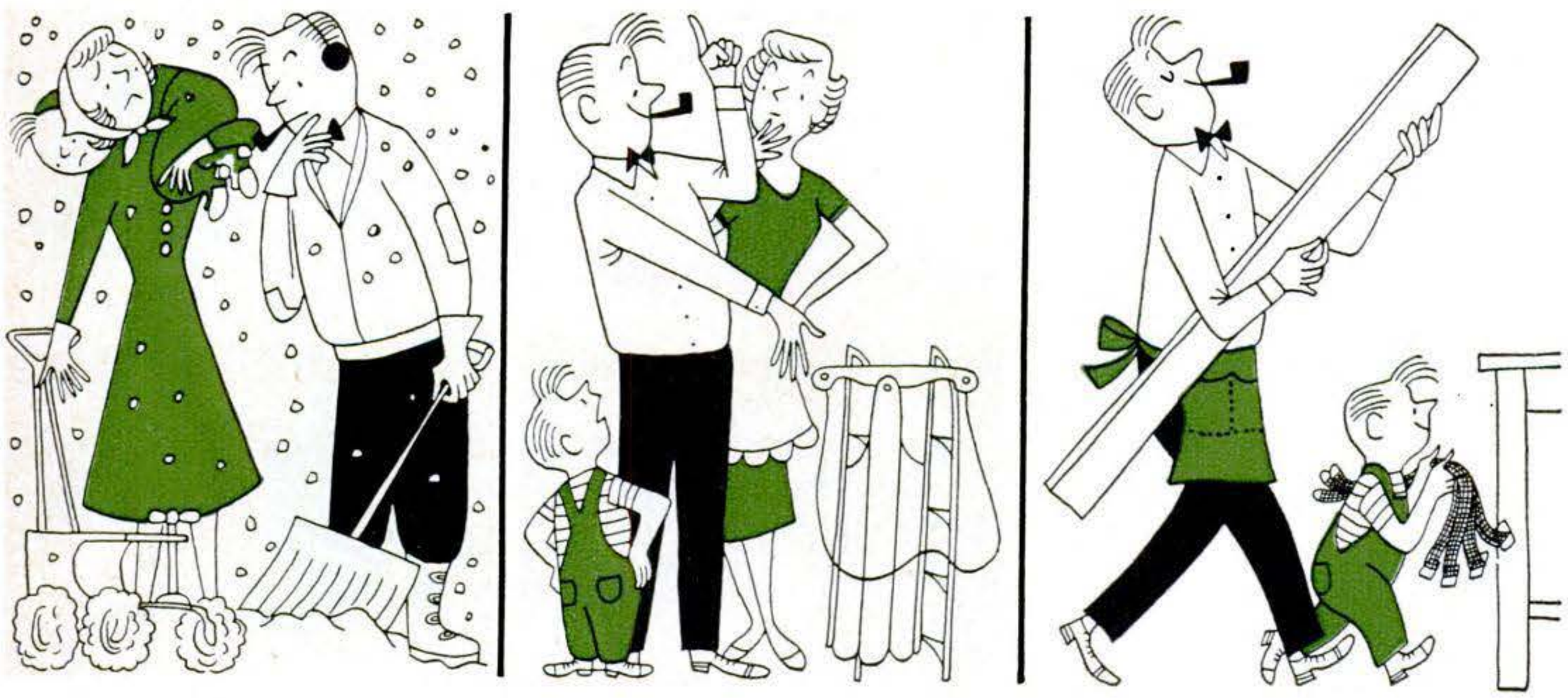
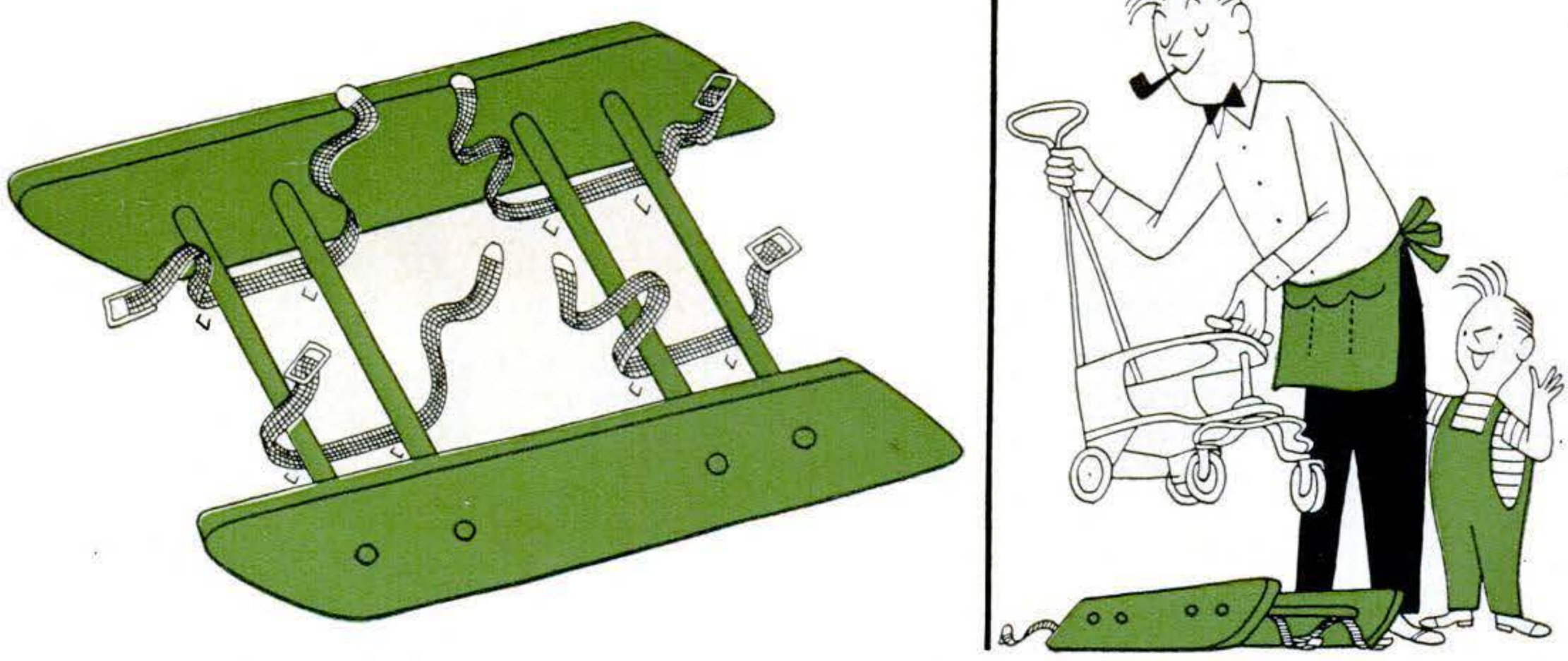
Wordless Workshop

By Roy Doty and C. W. Shutt







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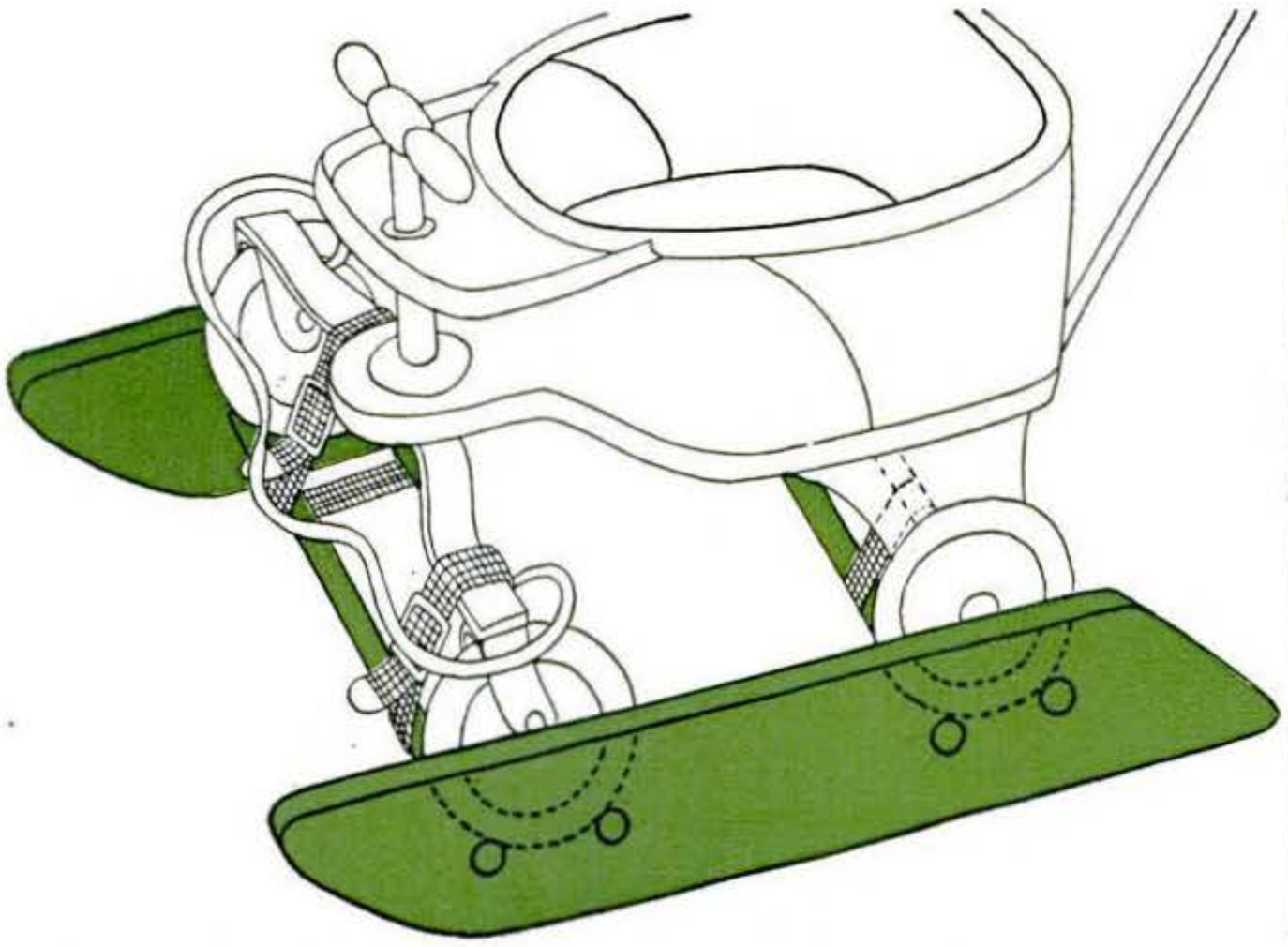

Next Month: Easy-to-reach bathroom mirrors for the whole family

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How to Quiet Noisy Plumbing

Do your pipes groan, rumble and bang every time they go into action? Here's how to hush them

By David X. Manners

YOU don't have to put up with the three biggest rackets in plumbing—pipes that hammer, faucets that chatter, drains that gurgle. Silencers for all three usually are close at hand.

1 *Water hammer: How to cushion it*

You get water hammer when water slams to a stop in a pipe. The faster the water is traveling, and the more sudden the stop, the worse the crash. Let it continue, and hammer can literally shake your plumbing apart at the joints.

What causes water hammer? It may be a sagging pipe, a pipe bent out of line or a pipe with inadequate support—particularly at elbows or other turns.

Rigid copper tubing in ½″ size should be supported every 6′, and ¾″ and 1″ tubing every 8′. Soft copper tubing should get even more support. But don't make hangers and clamps so tight that they prevent normal expansion and contraction of the pipe.

At corners, first determine the direction in which water flows. Then install a brace against the section of pipe that the water hits in making the turn. You can use a pipe hanger, a wood block or a shelf bracket as a brace—anything to keep the pipe from moving under the impact of the water.

An air chamber, a device for cushioning the slamming water, is called for if snugging up the pipes is not enough to stop the racket.

The simplest type of anti-hammer cushion is a vertical capped length of pipe attached to the supply line just before the fixture. Air trapped in this dead-end pipe will compress under the impact of the moving water and absorb the blow.

Anti-hammer chambers can be as short as 12″ to 18″ and the same diameter as the supply pipe. But a chamber will be more effective, and remain effective longer, if it's at least 24″—and greater in diameter than the supply pipe. For ⅜″ supply pipe use a ¾″ chamber pipe, for ½″ use 1″, for ¾″ use 1¼″, and for 1″ use 1½″. A reducer fitting will connect the two sizes. If it's not possible to install an air chamber at the fixtures, a 3′ air pipe installed near the water meter may do the job almost as well.

Even a line already protected by an air chamber may become noisy. Draining the line will drain the chamber. A commercial silencer that won't get waterlogged costs about $5.

Hissing, humming and other pipe noises are caused by fast-moving water. You'll notice these mostly in the silence of night when water pressure is generally up quite high.

A pressure of 40 to 50 pounds per square inch is best. Yet in many areas

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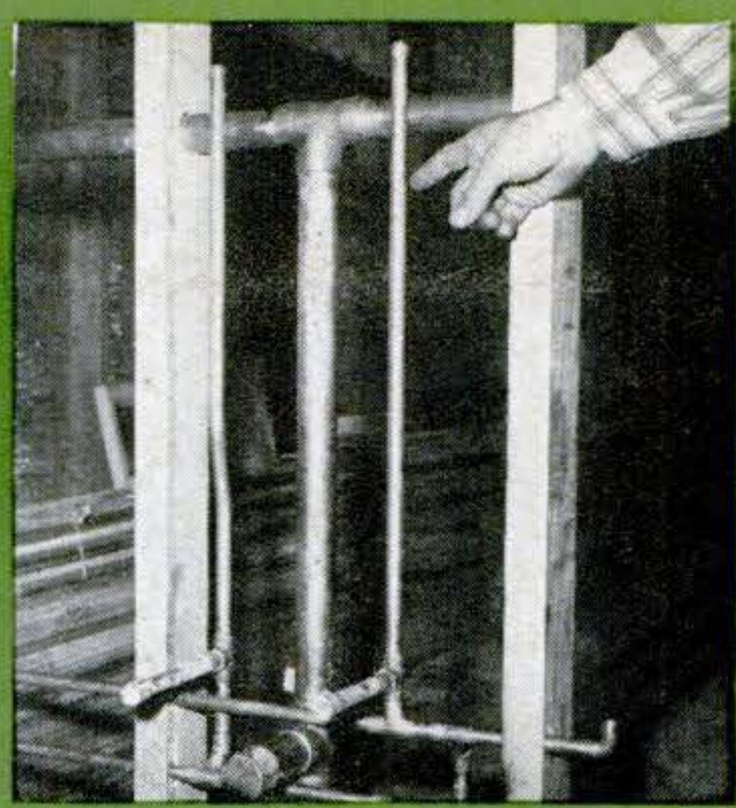
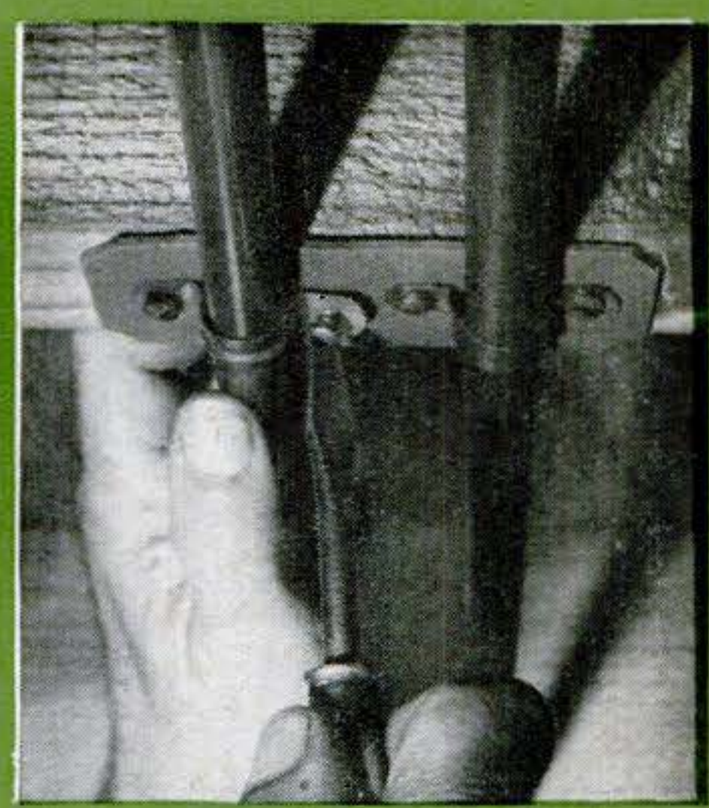
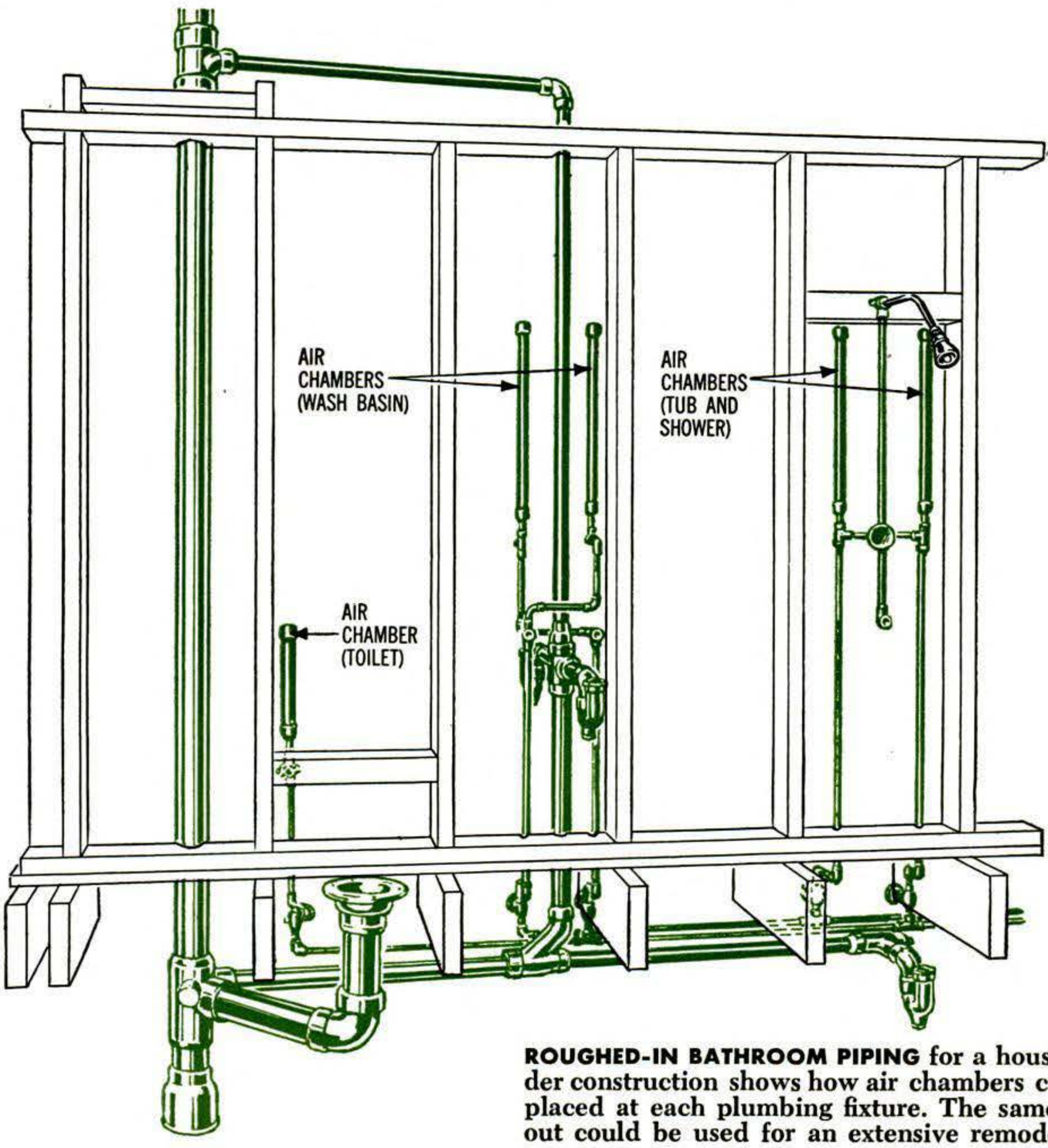
REDUCE THE SPEED of rushing water with a pressure regulator inserted just after the meter. Forty pounds is about right; unchecked, water pressure may climb to double that much.



ABSORB WATER HAMMER by adding an air chamber to the supply line near each fixture. You can easily make an effective chamber from a 2′ length of pipe capped at one end.



DEADEN VIBRATIONS by supporting your water lines every 6′ to 8′. Fiber or rubber strips will keep a rattling pipe from making your house structure serve as its sounding board.



ROUGHED-IN BATHROOM PIPING for a house under construction shows how air chambers can be placed at each plumbing fixture. The same layout could be used for an extensive remodeling.

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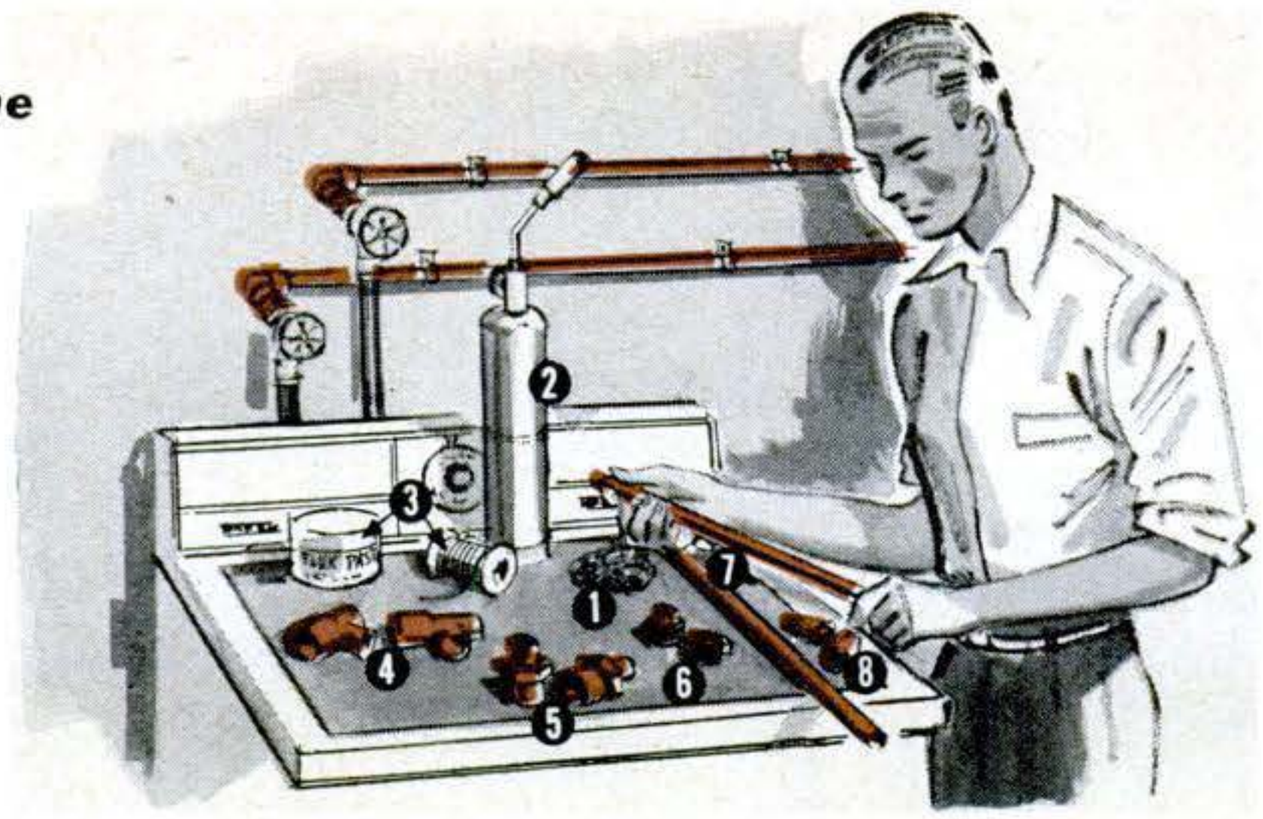
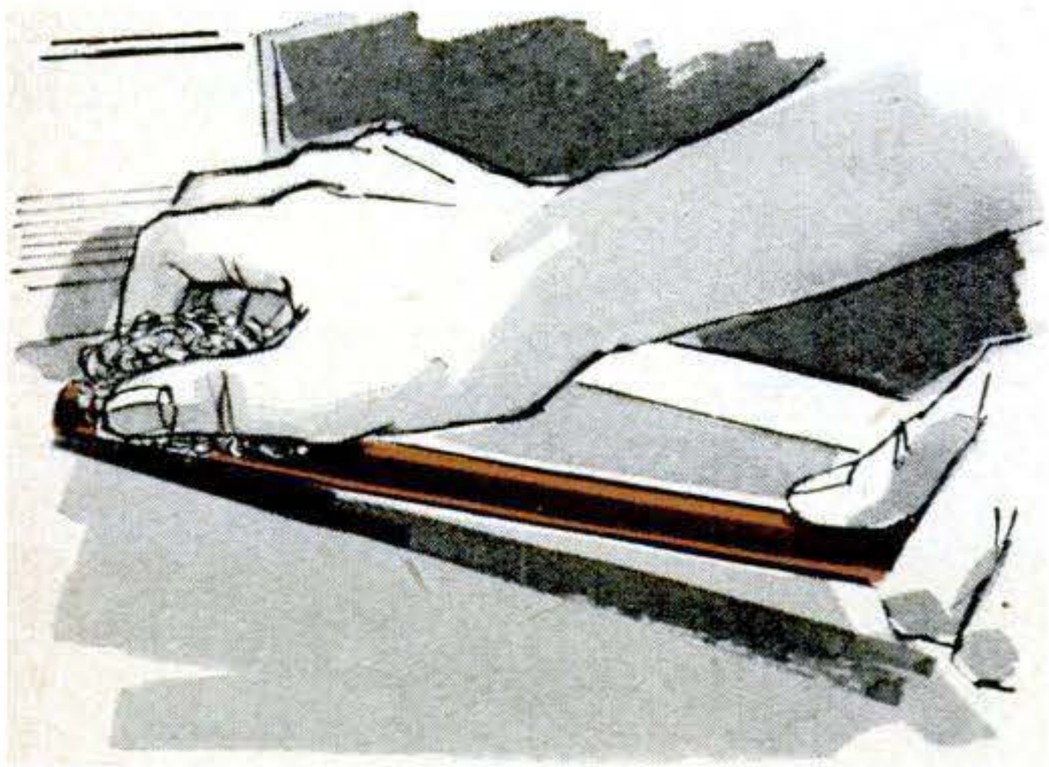
Are quick-acting valves on your automatic washer making the pipes talk back? Here's a cure

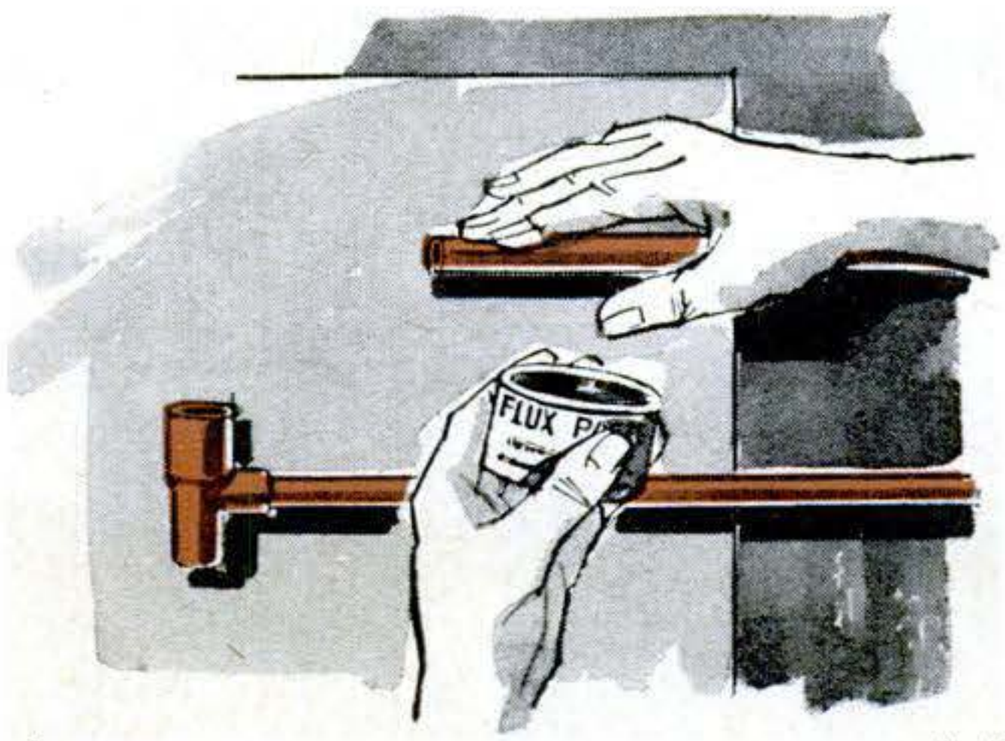
How to Install Anti-Hammer Chambers



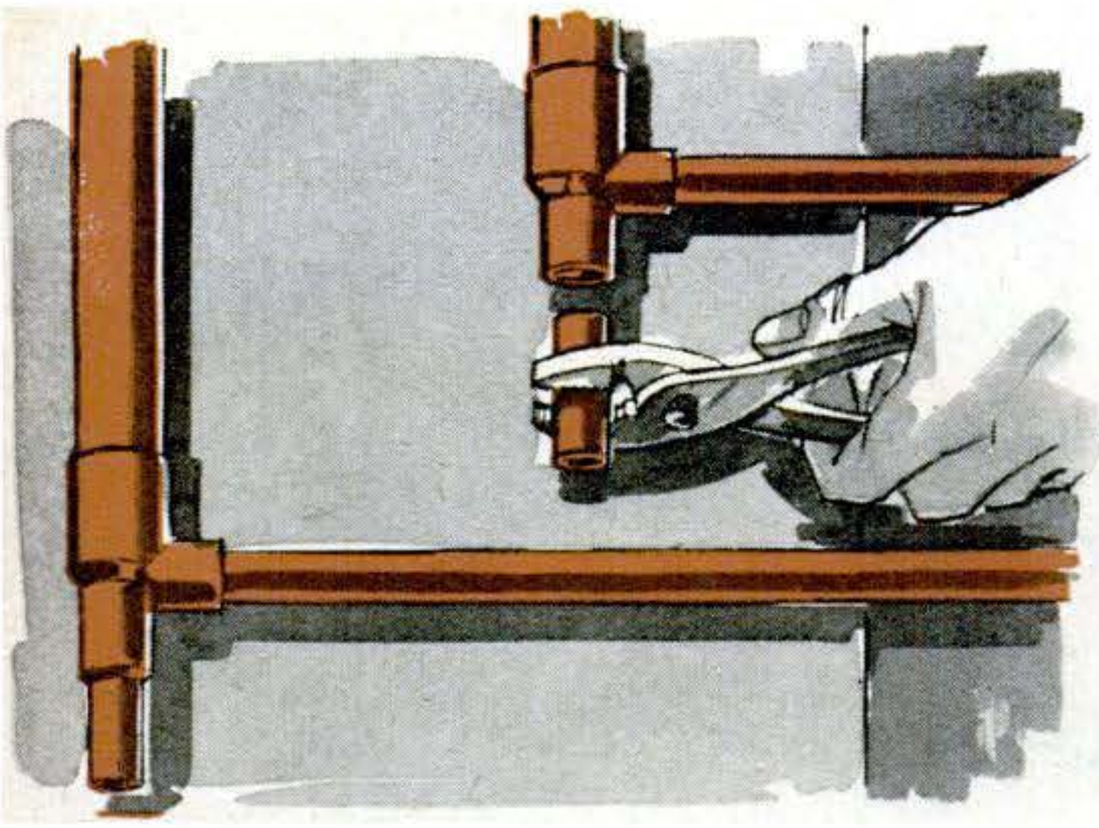
1 SHOCK ABSORBER takes impact when water is turned off abruptly. It consists of columns of air trapped in chambers made from simple fittings. Here's what you need: 1. steel wool; 2. torch; 3. solid-wire solder and flux; 4. two reducing tees (¾″ copper to ½″ copper to ½″ copper); 5. two adapters (¾″ copper to ¾″ inside threads); 6. two ¾″ brass plugs; 7. two 2′ lengths of ¾″ rigid copper tubing; 8. two ½″ copper nipples, each 1″ long.



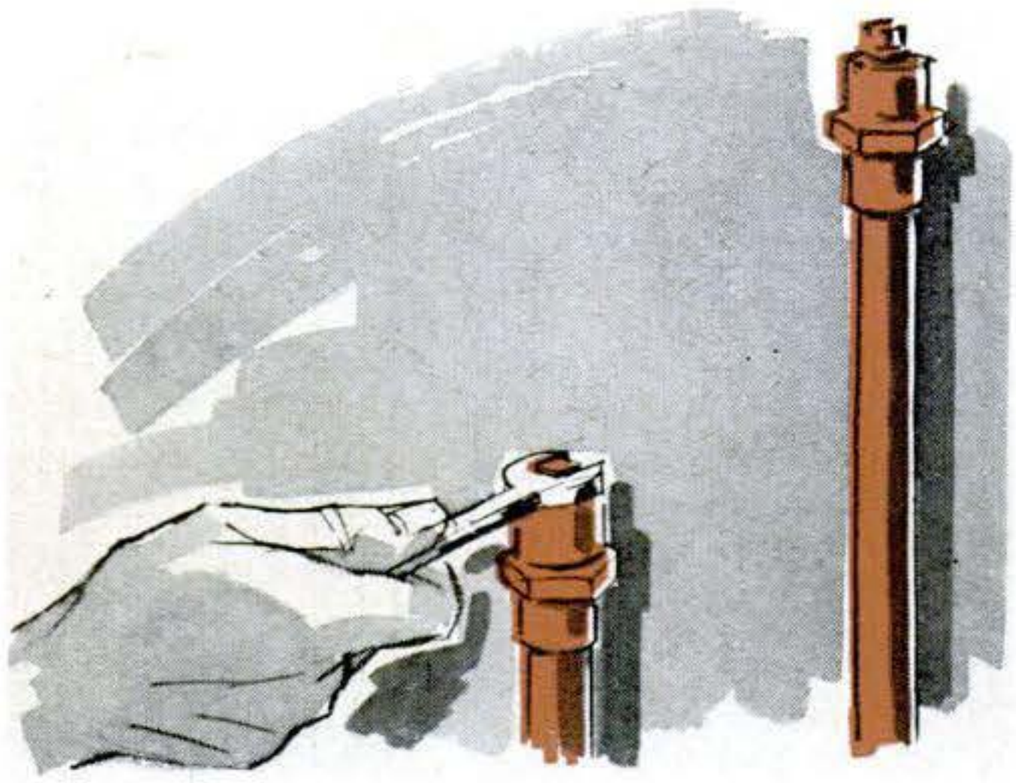
3 BURNISH ALL TUBE ENDS and interiors of fittings with steel wool or sandpaper. Unless you remove oxidation from copper, solder won't completely bond and seal the joints. Doing the job right the first time will pay off.



4 SMEAR FLUX ON WATER-LINE ENDS and slip reducing tees over them as shown. Heat the joints until solder held against them flows freely into the connections all around. Do the same with all successive joints.



6 CONNECT TEES TO ELBOWS behind the sill cocks with 1″-long nipples. You may find that you have to spread the water lines slightly apart in order to provide sufficient clearance for the sill cock on the upper line.



7 THREAD BRASS PLUGS TIGHTLY into the adapters at the tops of the anti-hammer chambers. A tight seal is important to prevent air leakage. Remove excess soldering paste from all joints with wood alcohol.

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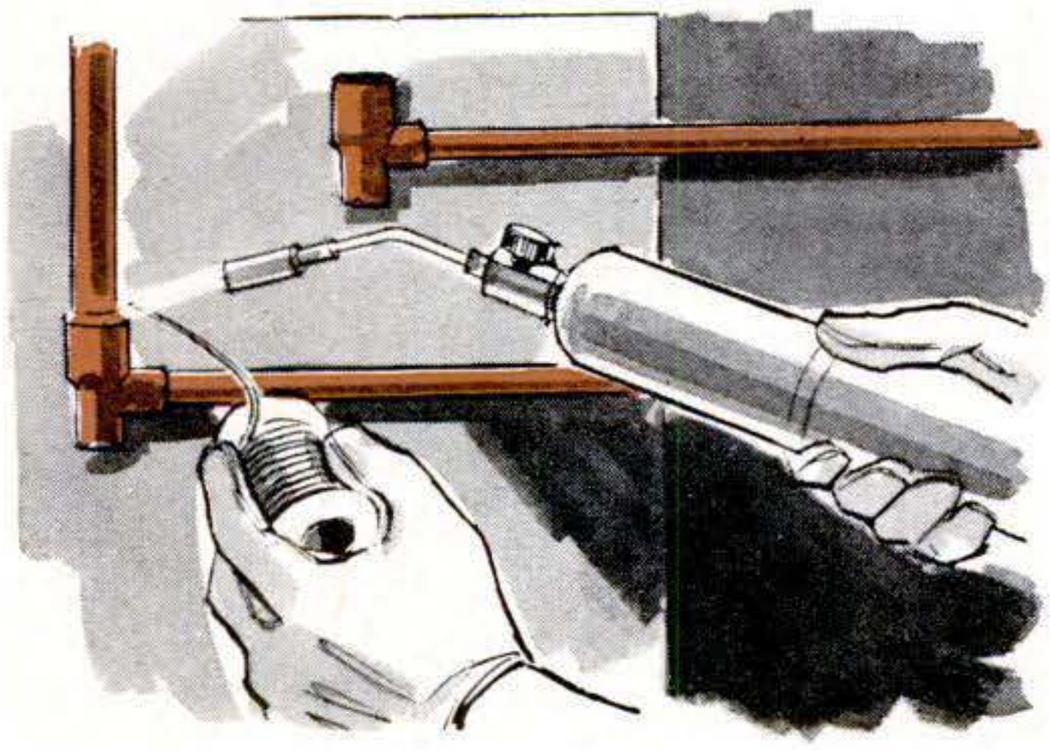
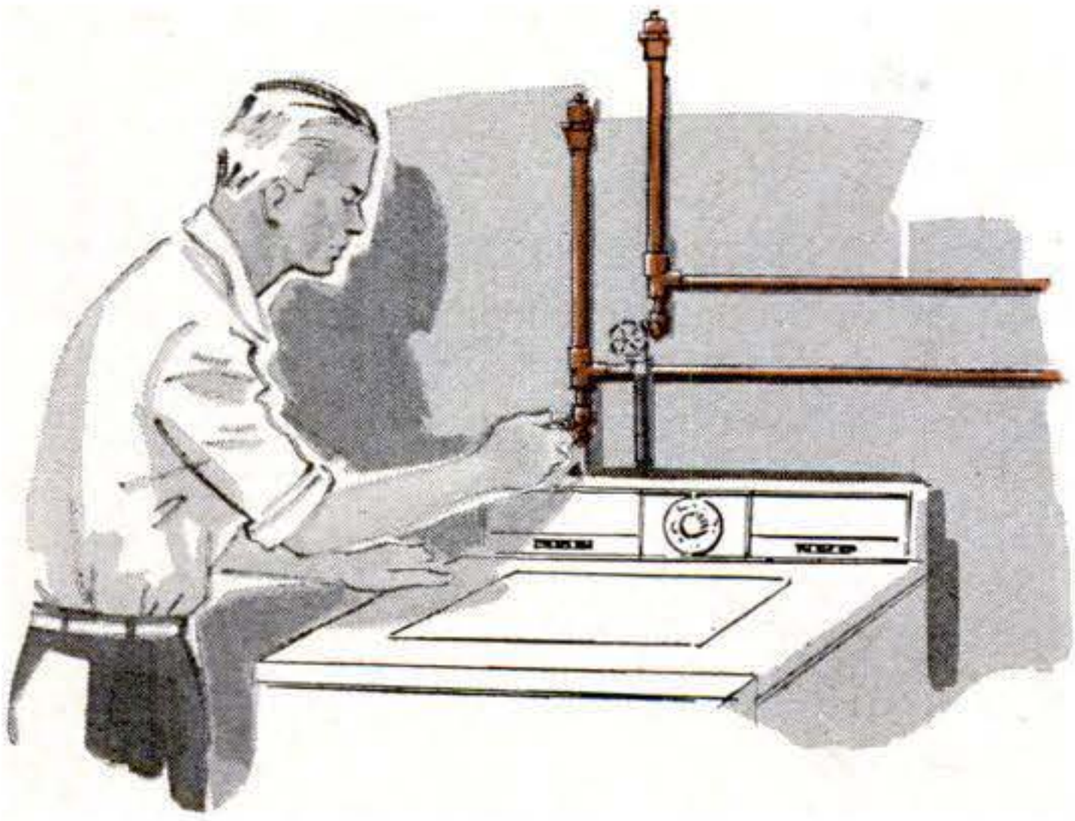
2 DRAIN WATER LINES and, with a torch, melt solder and remove elbows behind the sill cocks from copper tubing. Back up joints with a piece of sheet metal if working close to a wall that could be scorched by flame.



5 SOLDER AN ADAPTER on one end of each 2′ length of ¾″ rigid copper tubing. Then solder the opposite ends of the tubing in the ¾″ receptacles of the reducing tees. These tubes will be the anti-hammer chambers.



8 TURN ON THE WATER. A shock-cushion of air will be trapped in each anti-hammer chamber. If the chambers eventually become waterlogged, drain the lines and remove the plugs again to restore their supply of air.

pressure is a joint-jolting 80 to 90 pounds during the day, even higher at night.

When you suspect pressure is too high, check with the water company. If it is, you can insert a pressure regulator set for 40 pounds in the supply line just after the meter. Cost: $12 to $15.

Inadequate piping, also, may cause water-flow noises. The piping may have been too small originally, or become too small because deposits and scale have choked it up. A telltale sign is that you have to open a faucet wide to get a good flow. New piping is about the only cure.

Copper tubing is noisier. If you are accustomed to galvanized plumbing and move to a house with copper, be prepared for more flow noises. Here are ways of keeping such noises to a minimum:

- If the piping is rigidly mounted to floor joists or wall studs, switch to a non-rigid mounting such as wire hooks.
- Back up pipe or tube straps with cushioning rubber or felt. Rainbow packing, a rubber sheeting available from plumbing-supply dealers, is excellent.
- Two or more coats of the asphalt-asbestos compound that is sometimes applied to pipes to stop sweating will also insulate against sound.
- Avoid overhead-feed installations when possible. Overhead-supply pipes are noisier than those coming to fixtures from below. That's because an overhead pipe traps air while an under-floor one lets bubbles rise and escape. You can dampen the noise and vibration of such an overhead feed with insulation or non-rigid suspension.

Pipe-insulating materials include glass wool and wool felt. For about $1 you can get 50′ of ½″-by-3″ wrapping-type glass wool plus 50′ of vapor-seal vinyl tape, enough to insulate 22′ of 1″ pipe, or 18′ of ¾″ pipe. Rigid-type glass wool and wool felt is sold in 3′ lengths at 20 to 25¢ per foot. Coverings for elbows, tees and other fittings cost about 50¢ apiece.

Rumbling in a hot-water line is usually caused by overheated water. This is most common with side-arm heaters and furnace water-heating setups where temperature control is difficult. What happens is this: When you turn on the faucet the pressure drops along the line and allows super-heated water to turn to steam in the heater coil or furnace knuckle. The more scale in a side-arm coil, the more

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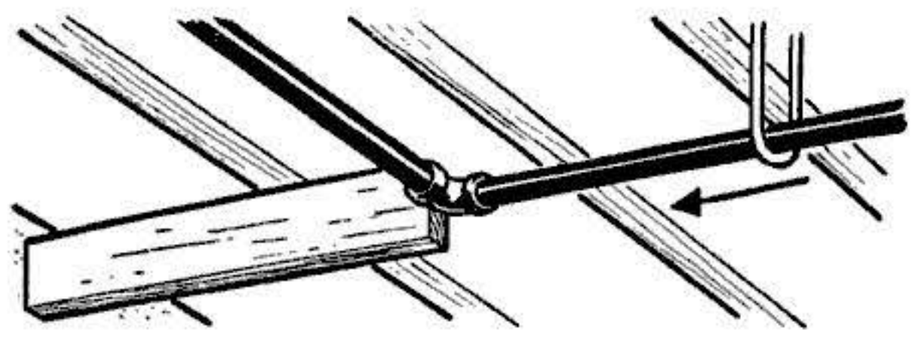

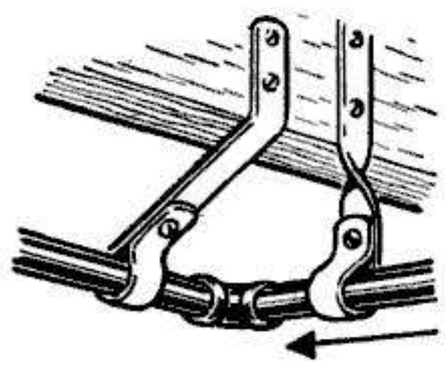

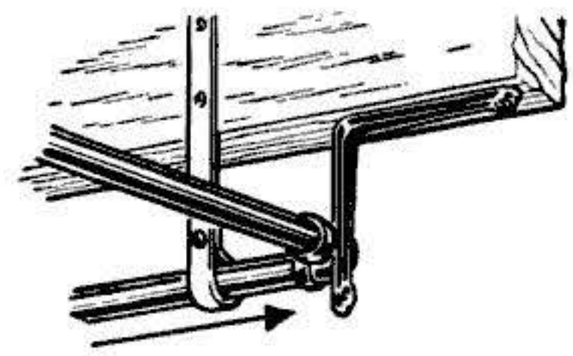

PIPE VIBRATIONS come when water turns a corner. It slams into an elbow and rattles the pipe. You can minimize this trembling by bracing the corner against the direction of flow, using one of the devices shown here: a short board, two pipe hangers or a shelf bracket.

rumble. Worse, clogging makes you heat the water more and more, to get enough. That, in turn, accelerates clogging.

A water softener or filter will extend the life of a heating coil. Serious clogging requires replacement. In a modern water heater with thermostatic control set for 130° to 140°, water won't rumble.

Heating systems sometimes develop loud and persistent hammering or knocking noises. Hammering in steam pipes is usually caused by water trapped in a low spot. When a house settles, a pipe may be lowered out of line, so that water can't drain off properly. Cure: Restore the pipe to its original pitch.

A radiator may knock because it's not level or because the valve is partly open. Shim up the radiator to level it and keep the valve fully open or closed.

2 *Drain noises: How to end them*

When an upstairs stack passes a living area on the floor below, how can you minimize the sound of the toilet flush? Recommended treatment: Wrap two or three layers of 1″ hair felt around the stack, each layer tied with jute twine at 1″ intervals. Cover the entire job with a waterproof membrane secured by pipe bands. Existing partitions may not be thick enough to accommodate this much insulation, but in remodeling you can often run the stack through a closet or box it into a corner.

Soil pipes will transfer noise to any partition walls through which they pass. Cure: Insulate them from these walls. It's best to avoid actual contact between pipe and wall. If you can't, then provide a resilient collar, the thicker the better.

When house drains gurgle: You punch an extra hole in the top of a beverage can to let air replace liquid as you pour. Similarly, house drains can't pass out their contents freely without vents to let in air. If sink, bath, or lavatory drains gurgle, though drain lines are clear, or if water goes down with a great sucking noise, it indicates the fixture's drain is not vented, is improperly vented, or its vent is clogged. The sucking noise means the drain trap is being siphoned dry of its water seal, letting sewer gas creep into the house through the waste line.

Here's what to do about it:

- If there is no vent: In existing systems where the cost of installing adequate vents would be prohibitive, most codes allow an anti-siphon trap. This eliminates noise, also protects health.
- If the vent is clogged: A vent requires occasional inspection. If not used, it may become clogged with leaves, twigs or dirt. In winter, it may get choked with frost, especially if its size at the roof line is under 3″. Just below roof line use an increaser fitting to step up 1½″ and 2″ vent pipes to 3″ or 4″.
- If the vent is inadequate: If the trap is over 5′ from a vent, install a vent closer, or use an anti-siphon trap.

3 *Faucet chatter: How to silence it*

A loose faucet part may cause pipe chatter. See if both washer and screw are tight. Next check the threaded faucet spindle and the housing into which it fits. Are they worn? Replace them.

Some noise is due to poor faucet design. A whistle in faucet or valve indicates too-close clearance there. Cure: Replace with a better faucet. END

Wobbly chairs? If you don't have the problem now, you probably will sooner or later. This fact sheet is designed to help you with the job when it comes along. Save it—along with others you'll find every month in POPULAR SCIENCE.

Next Month: Squeaking floors.

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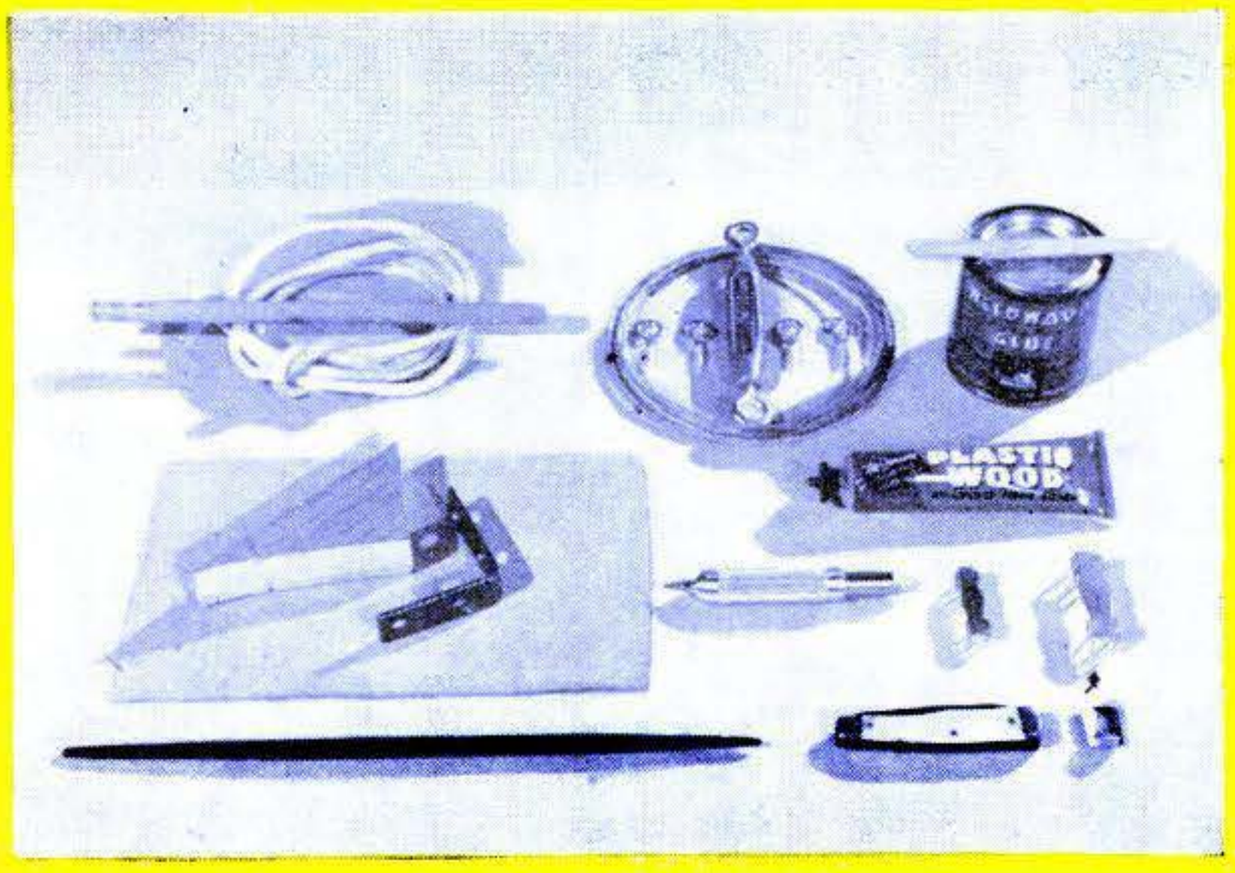
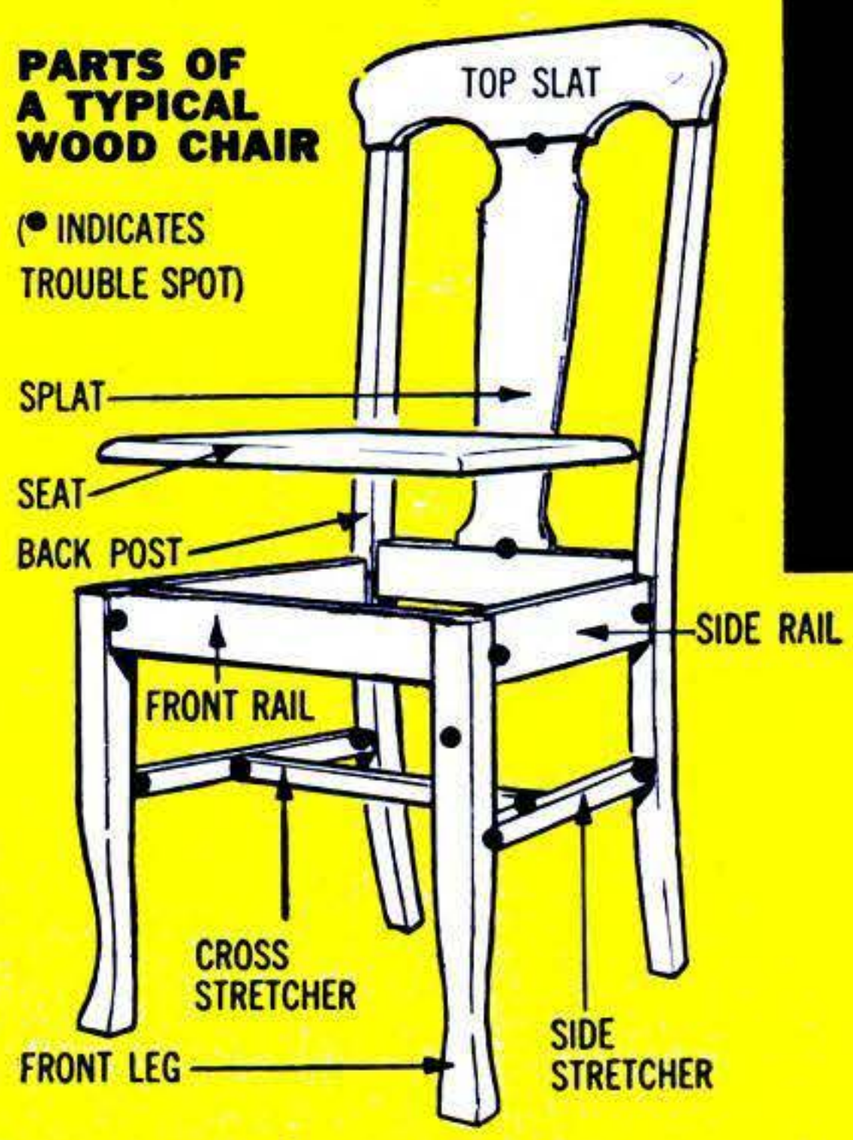
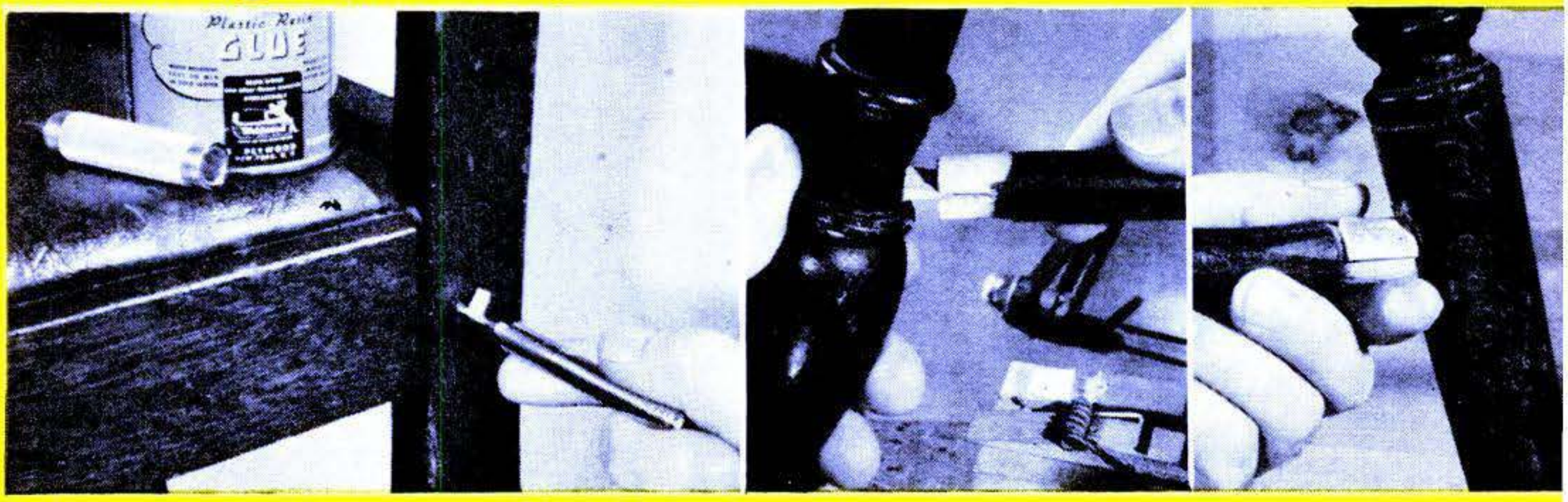
Popular Science Fix-It File



TOOLS AND MATERIALS YOU MAY NEED: Top row: clamping rope and dowel, turnbuckle, wire, glue. Center row: sandpaper, corner block, inside-corner angle brace, glue injector, wood putty, metal fasteners. Bottom row: wood file, knife, rung fastener.



How to tighten loose joints

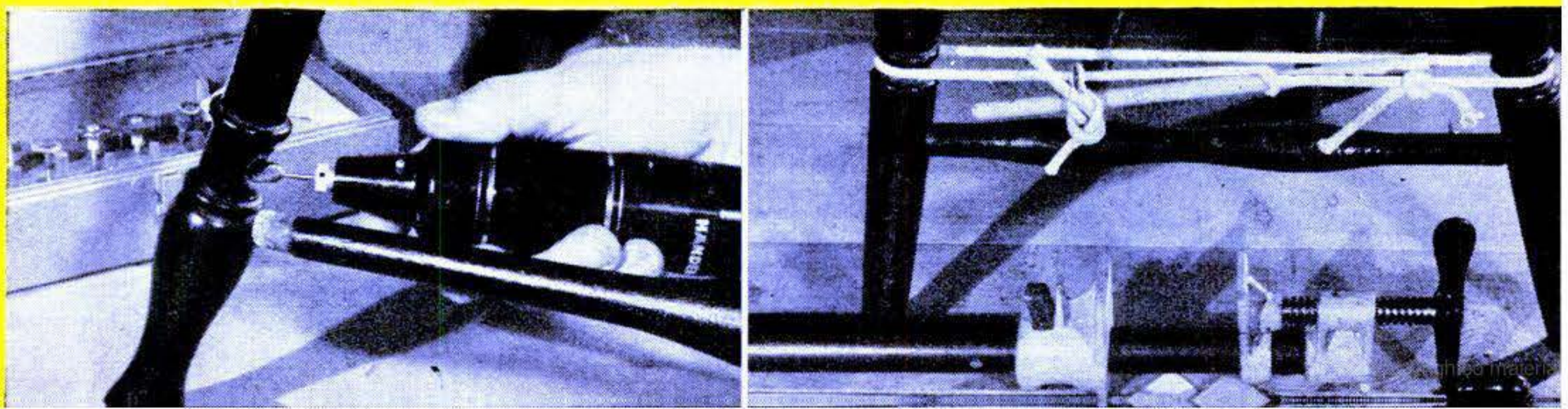


GLUE INJECTOR (about $2) will reinforce joints that are still fairly snug, but need regluing. Bore a hole into the joint with the tool's drill attachment, using tape as a depth stop. Then remove the drill, fit the injector needle into the hole, and press the plunger, forcing glue into the joint. Fill the hole made by the plunger with wood putty.

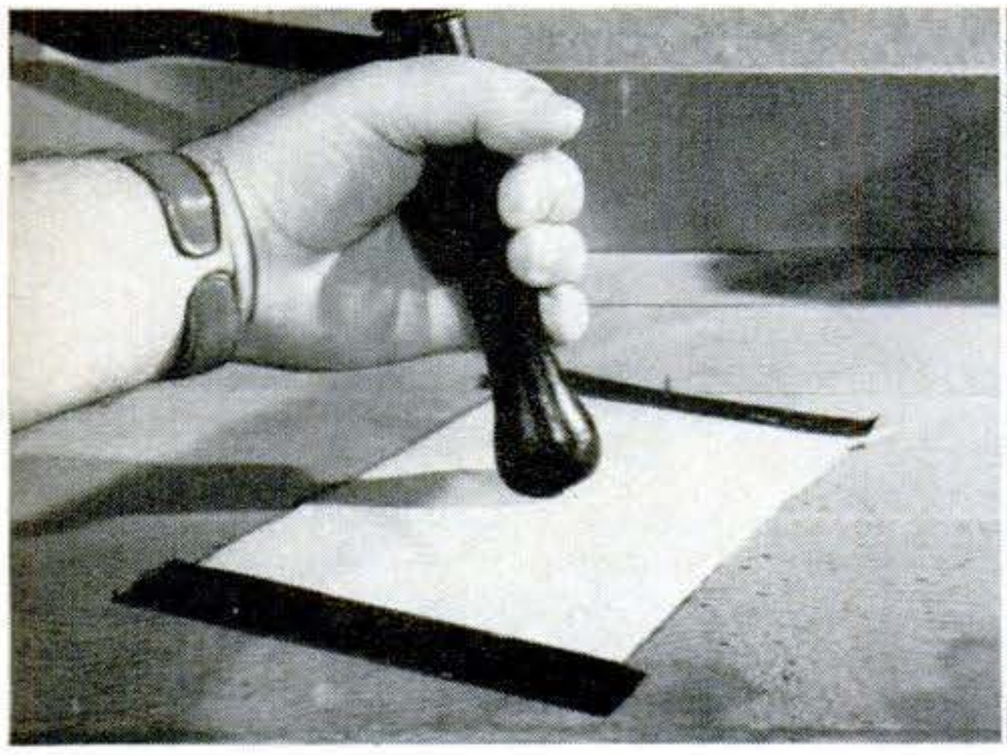
WEDGES OR RUNG FASTENERS make very loose joints tight again. A satisfactory wedge can be cut from a clothespin if other hardwood is lacking. Inserted in a saw cut (above, left) it expands the rung when driven home. Metal rung fasteners (right) have cleats that bite into both joined members of the chair, acting as locks as well as wedges.

REMOVE OLD GLUE from joint surfaces with a rotary cutter, file or knife, before regluing. Apply plenty of new glue (preferably plastic resin), thickened with fine sawdust if necessary for a snug fit. Wipe away any squeeze-out of excess glue with a damp cloth.

STEEL BAR CLAMP, used with cushioning blocks, is best for drawing joints together and holding them until glue sets. But clothesline, twisted taut with a dowel, makes a good substitute. The dowel end is tied to the line, as shown, to maintain tension.



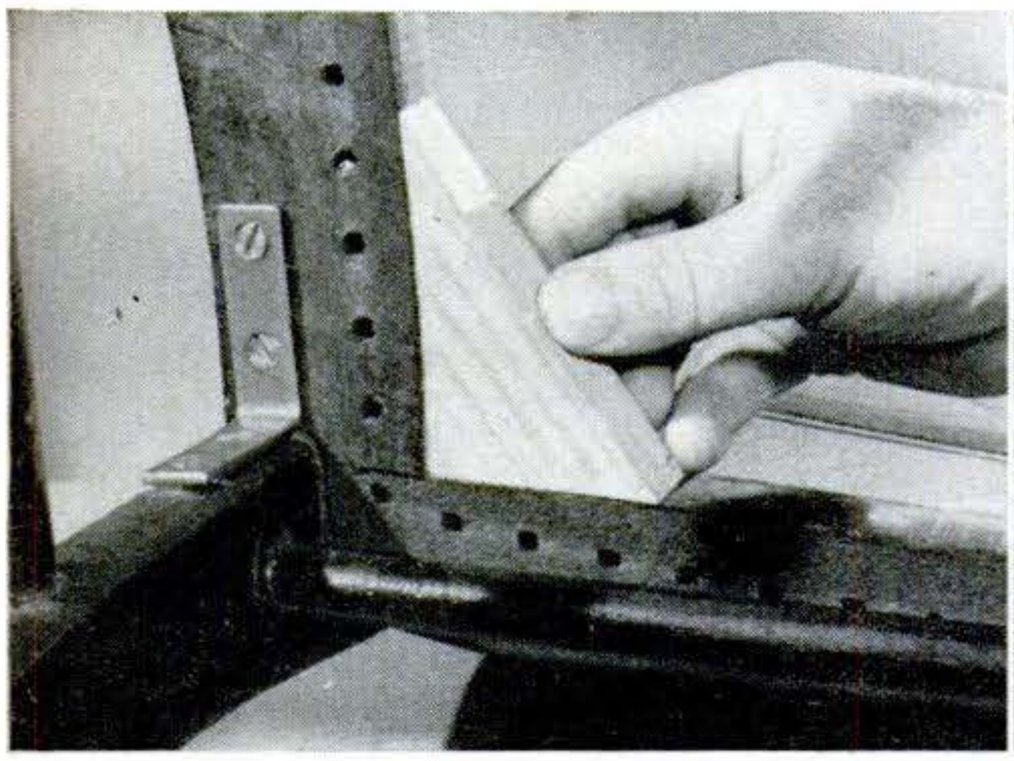
Tips to prevent teetering, mismated joints



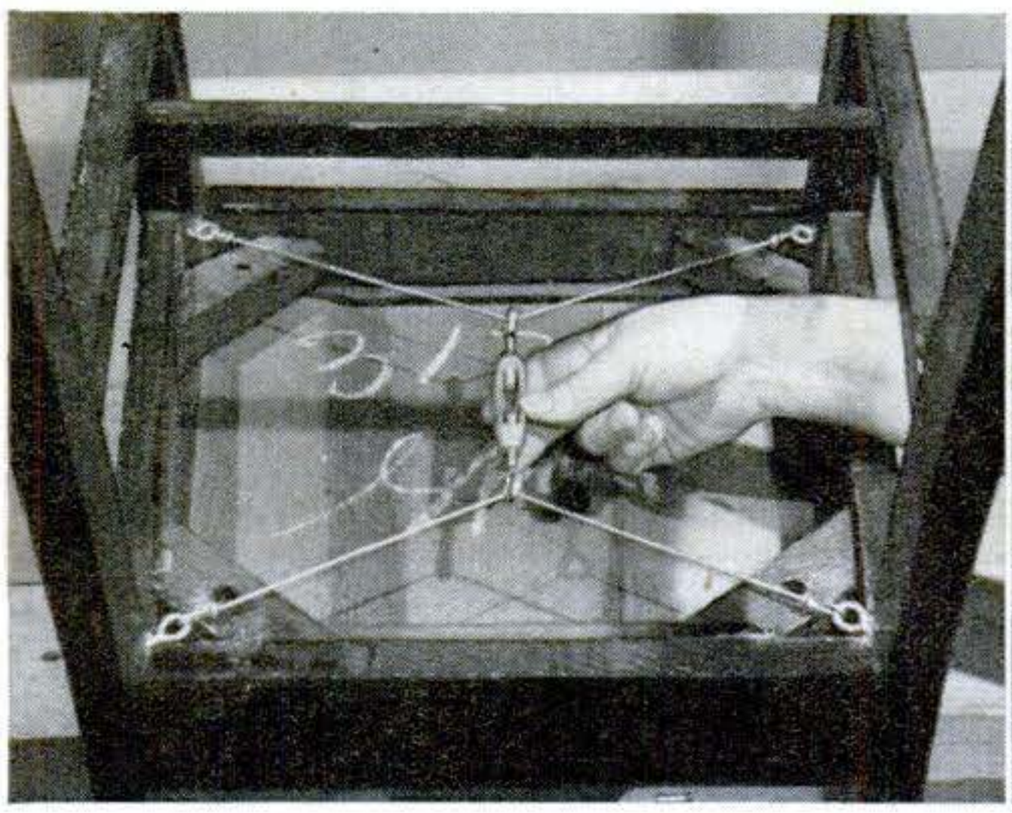
CHAIR LEGS THAT TEETER after regluing, or leg ends that do not rest flat on the floor, put a strain on joints and mar floor finishes and coverings. Tape coarse sandpaper to a flat surface and work legs back and forth on the abrasive until the bottoms are even.

KEY THE JOINTS before taking a chair apart for regluing, to insure correct reassembly. Small pieces of adhesive tape make good numbering tabs. Chairs are easier to disassemble if they are stored in a warm, dry spot for several days before you start the job.

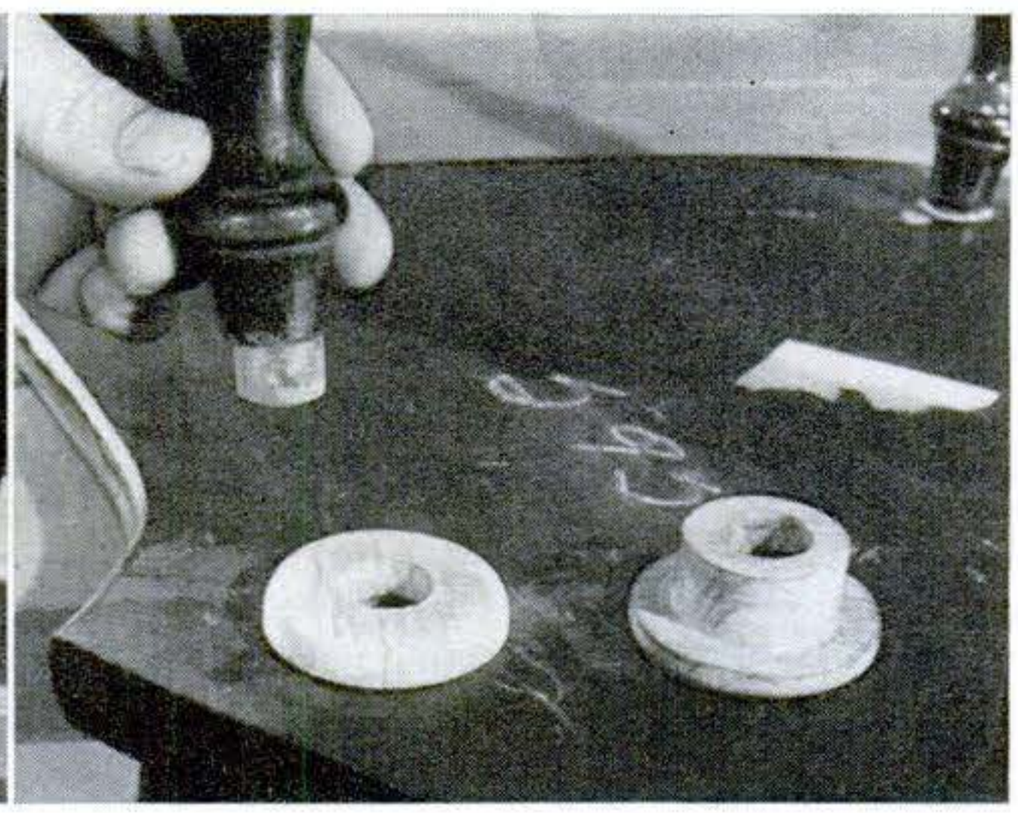
How to repair seat-frame members



STIFFEN LOOSE SEAT-FRAME JOINTS with hardwood corner blocks either glued, or glued and screwed, in place. Use inside-corner angle braces to strengthen leg-frame joints. Alternate way is to use special metal fasteners with curved teeth that draw the parts together as they're driven home. The fasteners come in several sizes.



SNUG UP WOBBLY RAILS like this. Turn screw eyes into back-post and front-leg corners; then join each pair with a length of wire passed through the eye of a turnbuckle. Tighten turnbuckle until wires are taut.



HARDWOOD PLUGS, turned on a lathe and bored to take leg dowels snugly, solve the problem of greatly enlarged or out-of-round seat sockets. Enlarge the sockets to accommodate the plugs. Use glue for assembly.

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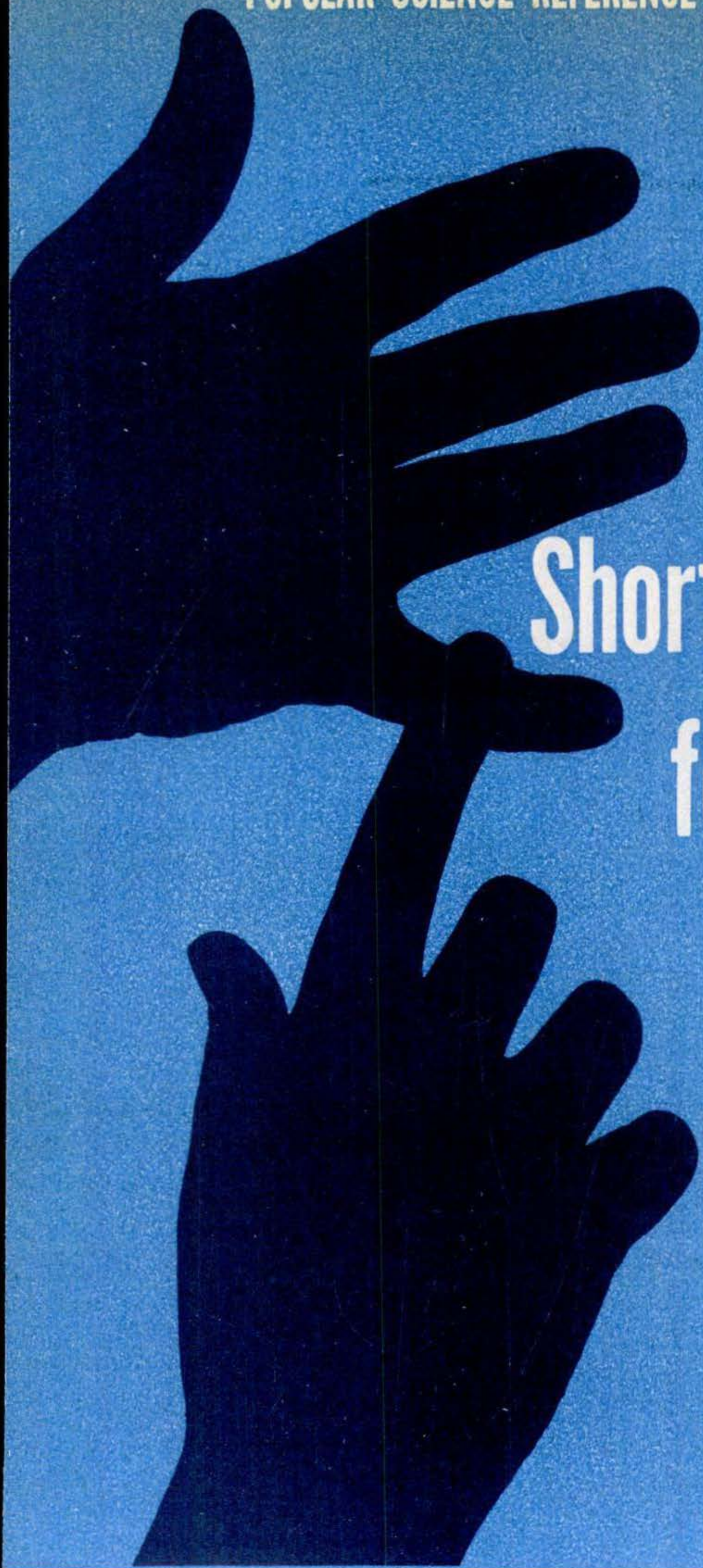

Math Short Cuts for the Home Owner

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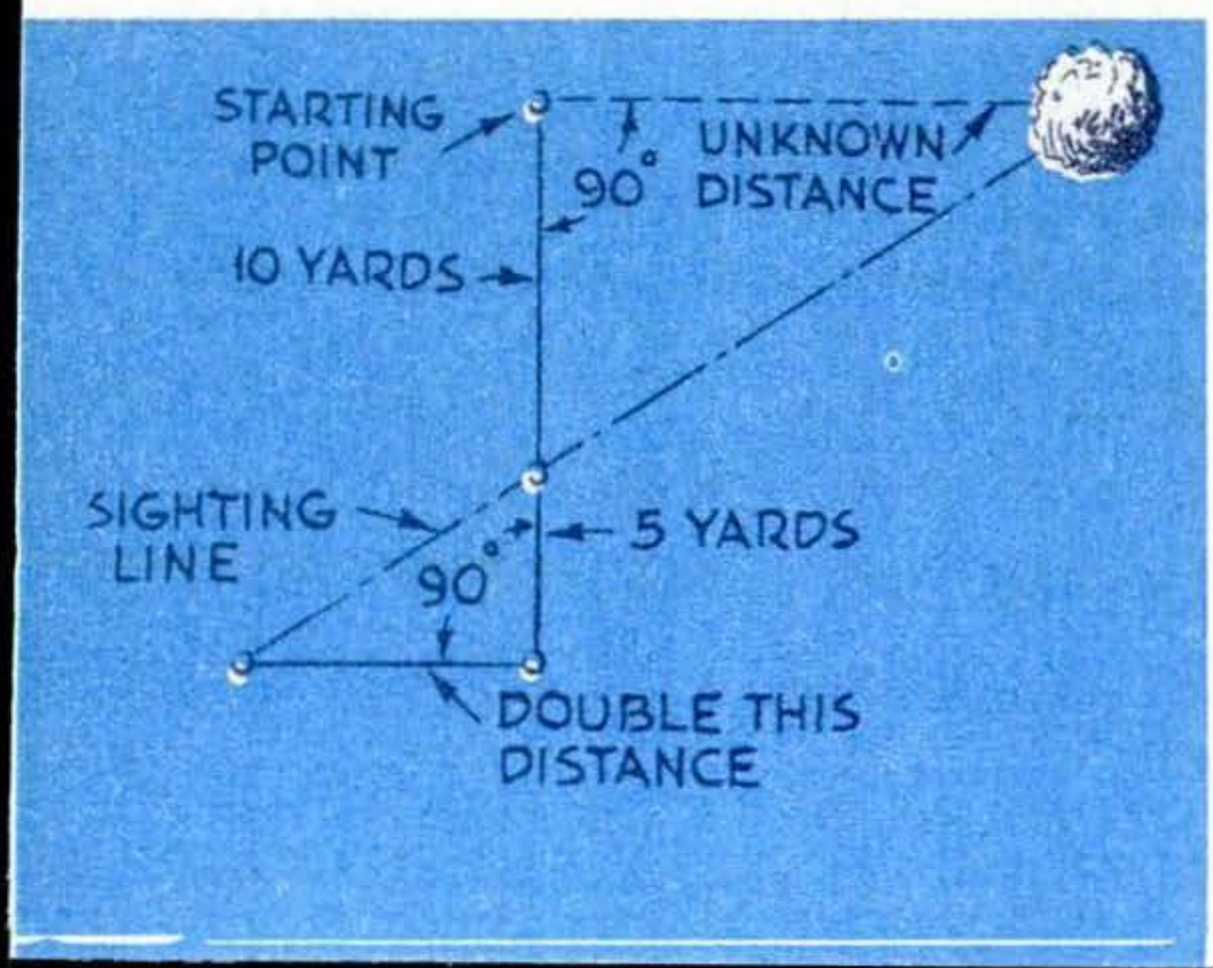
Measuring

Calculating distances. How can you figure the distance to an object you can't get to? Starting at the point from which you want to take your measurement, run a line at right angles to the direction of measurement. Drive two stakes on this line, one 10 yards from the starting point, the other 15 yards. Next, run a line back from the 15-yard marker at right angles to the first line. Extend it to a point from which you can sight across the 10-yard marker to the distant object. Drive a stake here. Measure the distance between this stake and the 15-yard marker, double it, and you have the desired measurement. You can substitute any pair of distances for the 10- and five-yard spacing of the stakes on the first measured line.



The unknown distance and the known distance of the second line will always be in the same proportion as the pair you choose.

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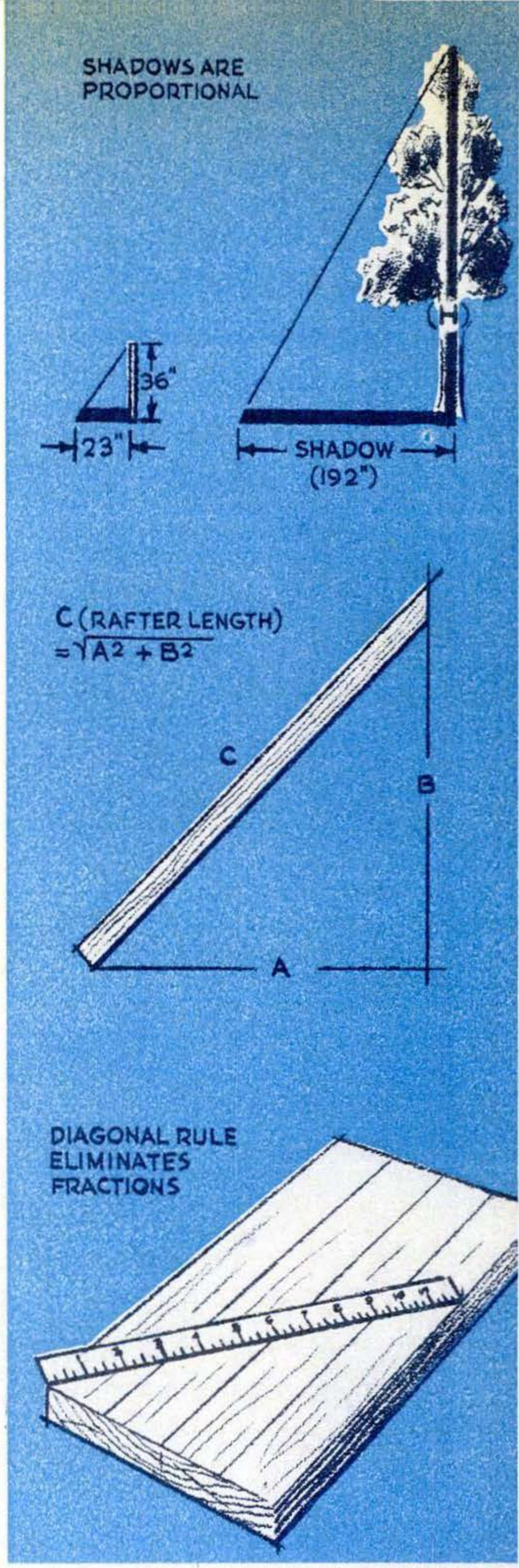
Figuring heights. Try this when you can't take a direct vertical measurement—the height of a tree, for example. Measure the length of the object's shadow. Then measure the shadow cast by a vertical stick of convenient length—say 36″. Assume that the object and the stick cast shadows 192″ and 23″ long, respectively. Using the fact that the height of the object (H) is to its shadow as the height of the stick is to its shadow, you get 36″:23″=H:192″. Multiply the two outside figures (36″ x 192″) and divide by the known inside figure (23″). The result is 300½″, or just over 25′.



Measuring a diagonal. To estimate the length of the diagonal side of a right triangle—the required length of a rafter, perhaps—add the squares of the two shorter sides together and find the square root of this figure.

Say a rafter must have a rise of 2′ in 10′, or 24″ in 120″. Multiply each of these latter figures by itself and add the products: 576 plus 14,400=14,976. From a table, by slide rule, or arithmetic, find the square root of 14,976 (122.37″, or about 10′ 2⅜″). That's your rafter length.

Dividing into equal parts. There's no need to bother with fractions when you want to divide a board of odd length into a number of equally wide strips. Just lay a rule across the board at such an angle that the diagonal measurement, in even inches, is easily divided by the number of strips you want. For example: You need four strips and the board is 11¼″ wide. Lay your rule on an angle that gives a 12″ reading. Mark the board at 3″, 6″, and 9″. When you scribe through these points you'll have equally spaced guide marks.

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Gauging with coins. Ever been caught without a ruler when you needed to know the thickness of a board? Money will help. The diameter of a U. S. cent is ¾″. Hold a penny against the edge of the stock and you can judge its thickness: ⅝″, ¾″ or whatever.

Coins are also handy for determining the nominal sizes of steel water pipe. If the inside diameter of a pipe is about half the diameter of a quarter, it's nominal ⅜″ pipe. If it's somewhat smaller than a dime, it's ½″ pipe. If a penny fits inside loosely, you have ¾″ pipe. In 1″ pipe a quarter will fit loosely, but a half-dollar won't go. If the opening is twice the diameter of a dime, the pipe is 1¼″. Combined diameters of a nickel and a penny approximately equal the inside diameter of 1½″ pipe. A half-dollar and a nickel add up to 2″ pipe.

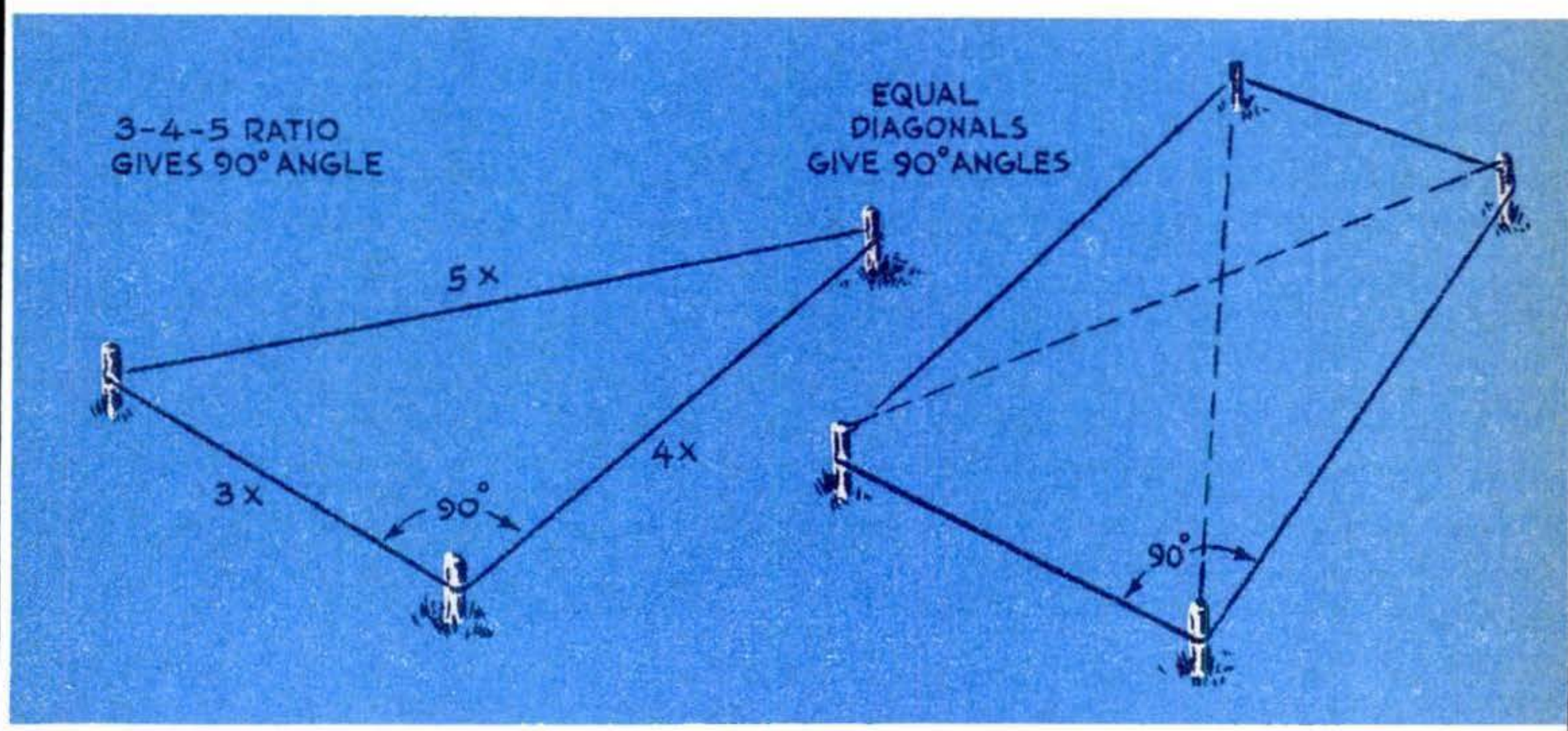
Plotting squares and angles

Working without a square. How can you square a project if you don't have a square, or true the corner markers for a building? Use the fact that a triangle whose sides are in the proportion of 3-4-5 is a right triangle.

With lines running both ways from a corner of your project, mark off 3′ in one direction, 4′ in the other. Run your tape from mark to mark. Move one of the lines until the distance between marks comes to exactly 5′. You have a precisely accurate 90° corner.

Squaring by diagonals. Say you've driven temporary stakes, and run lines for a building. You've made each pair of sides of exactly equal length. Other than by squaring a corner, how can you find out whether you have a true rectangle or square?

Measure the diagonals. If they're equal, all corners are square. If one diagonal is longer, shift the stakes.



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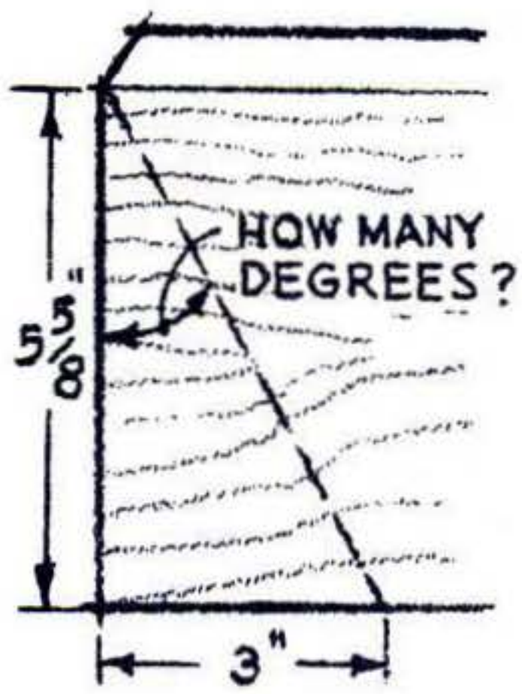
Angle	Tan	Angle	Tan	Angle	Tan	Angle	Tan	Angle	Tan	Angle	Tan
0°	.0000	15°	.2679	30°	.5774	45°	1.0000	60°	1.7321	75°	3.7321
1°	.0175	16°	.2867	31°	.6009	46°	1.0355	61°	1.8040	76°	4.0108
2°	.0349	17°	.3057	32°	.6249	47°	1.0724	62°	1.8807	77°	4.3315
3°	.0524	18°	.3249	33°	.6494	48°	1.1106	63°	1.9626	78°	4.7046
4°	.0699	19°	.3443	34°	.6745	49°	1.1504	64°	2.0503	79°	5.1446
5°	.0875	20°	.3640	35°	.7002	50°	1.1918	65°	2.1445	80°	5.6713
6°	.1051	21°	.3839	36°	.7265	51°	1.2349	66°	2.2460	81°	6.3138
7°	.1228	22°	.4040	37°	.7536	52°	1.2799	67°	2.3559	82°	7.1154
8°	.1405	23°	.4245	38°	.7813	53°	1.3270	68°	2.4751	83°	8.1443
9°	.1584	24°	.4452	39°	.8098	54°	1.3764	69°	2.6051	84°	9.5144
10°	.1763	25°	.4663	40°	.8391	55°	1.4281	70°	2.7475	85°	11.4301
11°	.1944	26°	.4877	41°	.8693	56°	1.4826	71°	2.9042	86°	14.3007
12°	.2126	27°	.5095	42°	.9004	57°	1.5399	72°	3.0777	87°	19.0811
13°	.2309	28°	.5317	43°	.9325	58°	1.6003	73°	3.2709	88°	28.6363
14°	.2493	29°	.5543	44°	.9657	59°	1.6643	74°	3.4874	89°	57.2900

"Tan" table for mitering. The accompanying table will often give you the miter setting for power sawing.

A tangent ("tan") of an angle in a right triangle is simply the length of the side opposite the angle, divided by the side that with it forms the right angle. Here's how to use tans. You have a two-by-six, actual width 5⅝". You want to set your saw to cut from one corner to a point 3" from the opposite corner. Divide 3 by 5⅝ to get .5333. The nearest figure to this on the tan table is .5317, which is close enough for most shop purposes. That's tan 28°—which is your setting for a radial-arm saw. For a table-saw miter-gauge setting, subtract 28° from 90°. To get a miter-gauge setting directly, figure the tangent of the other acute angle, instead. (Divide 5⅝ by 3 to get 1.875—tan 62°).



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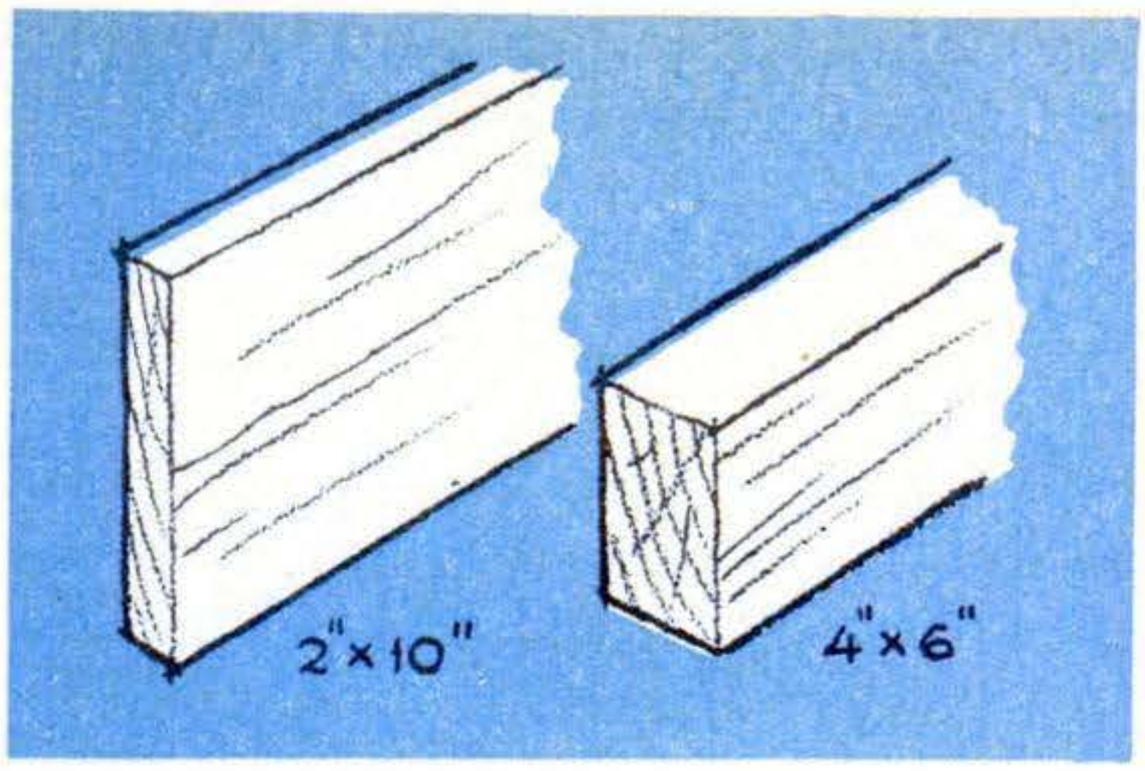
Structural strength

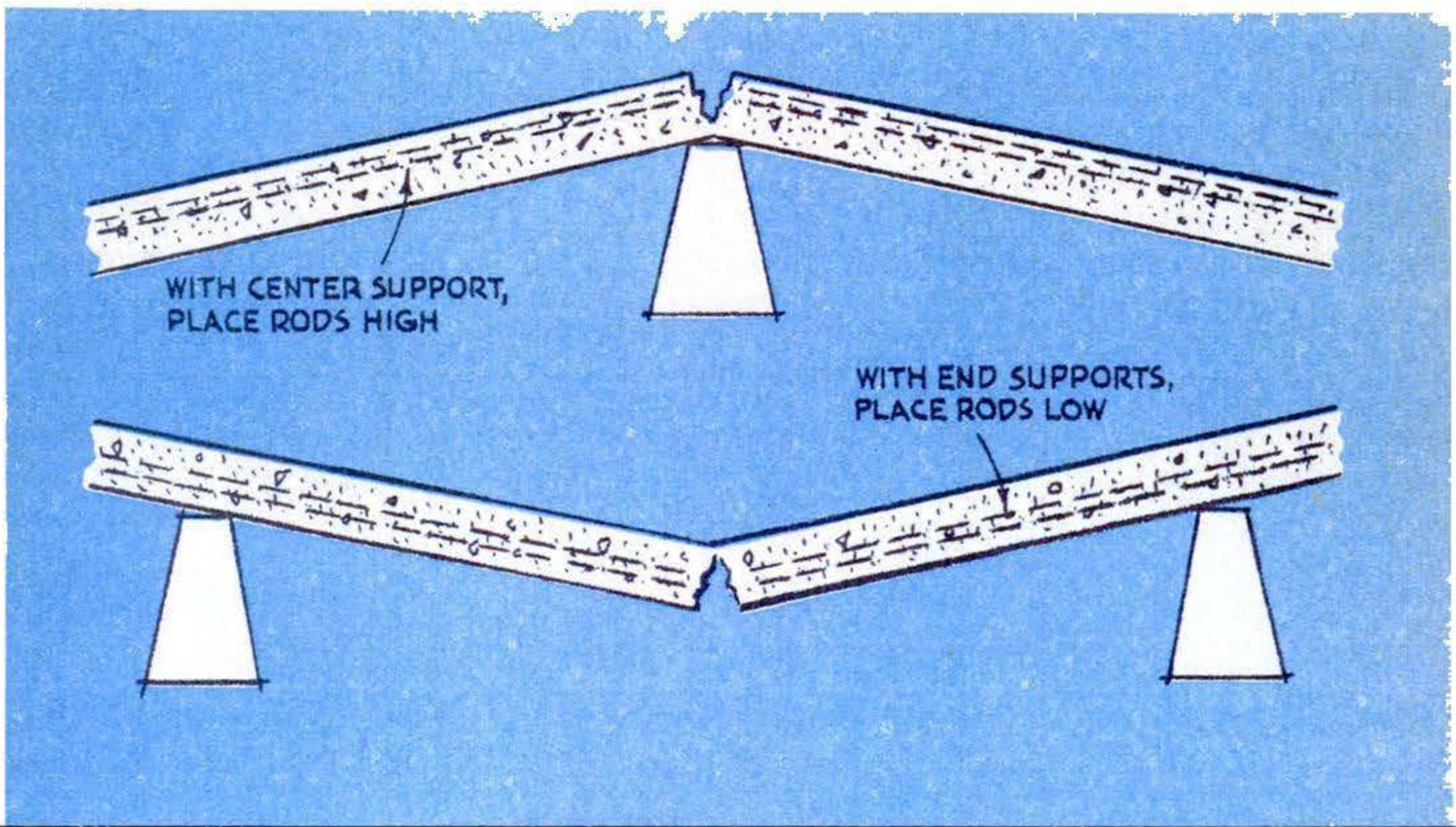


Beam strength. Comparing the cross-sectional areas of two beams does not necessarily give you their relative strength. For example: A full two-by-ten joist will take about a 39-per-cent greater load than a full four-by-six, although it weighs and costs one-sixth less. Use the following formula for determining load-bearing strength: Square the dimension in the direction of the stress, and multiply that figure by the other dimension. With the two-by-ten you get 10x10x2, or 200, as against 6x6x4, or 144 for the four-by-six. The difference in strength between dressed lumber and its nominal size is so slight that for practical purposes it need not be considered.

Beam stiffness. Stiffness refers to how much a beam will bend under a given weight. The formula for determining it is: width, multiplied by the cube of the depth.

Comparing a full two-by-ten with a full four-by-six, you have 2x10x10x10 vs. 4x6x6x6, giving a ratio of 2,000 to 864. So although the four-by-six contains more lumber and costs more, it will sag 2⅓ times as much as the two-by-ten beam when it is carrying the same load.

Reinforcing concrete. Here's a trick that makes reinforcing rods or mesh do the best possible job of internal bracing. Remember that concrete is strong under compression, but weak under tension. So place the rods where the concrete will tend to pull apart under load. In other words, if a slab is to be supported centrally, place the reinforcing rods high in the concrete. On the other hand, if the slab will be supported at the ends, embed the rods near the bottom. Either way, be sure that they are far enough from any surface to be strongly keyed in the concrete.



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Estimating materials

How much concrete? To find the amount of concrete needed for a slab, multiply the length and width, using feet, then divide by the number of times the thickness, in inches, goes into 12, for the cubic footage. Order four yards of concrete for each 100 cubic feet and you'll be allowing eight percent for waste. Here's an example: You want a 6″ slab for a 12′-by-20′ garage. Divide 240 by two and you get 120 cubic feet. Five yards will do the job.

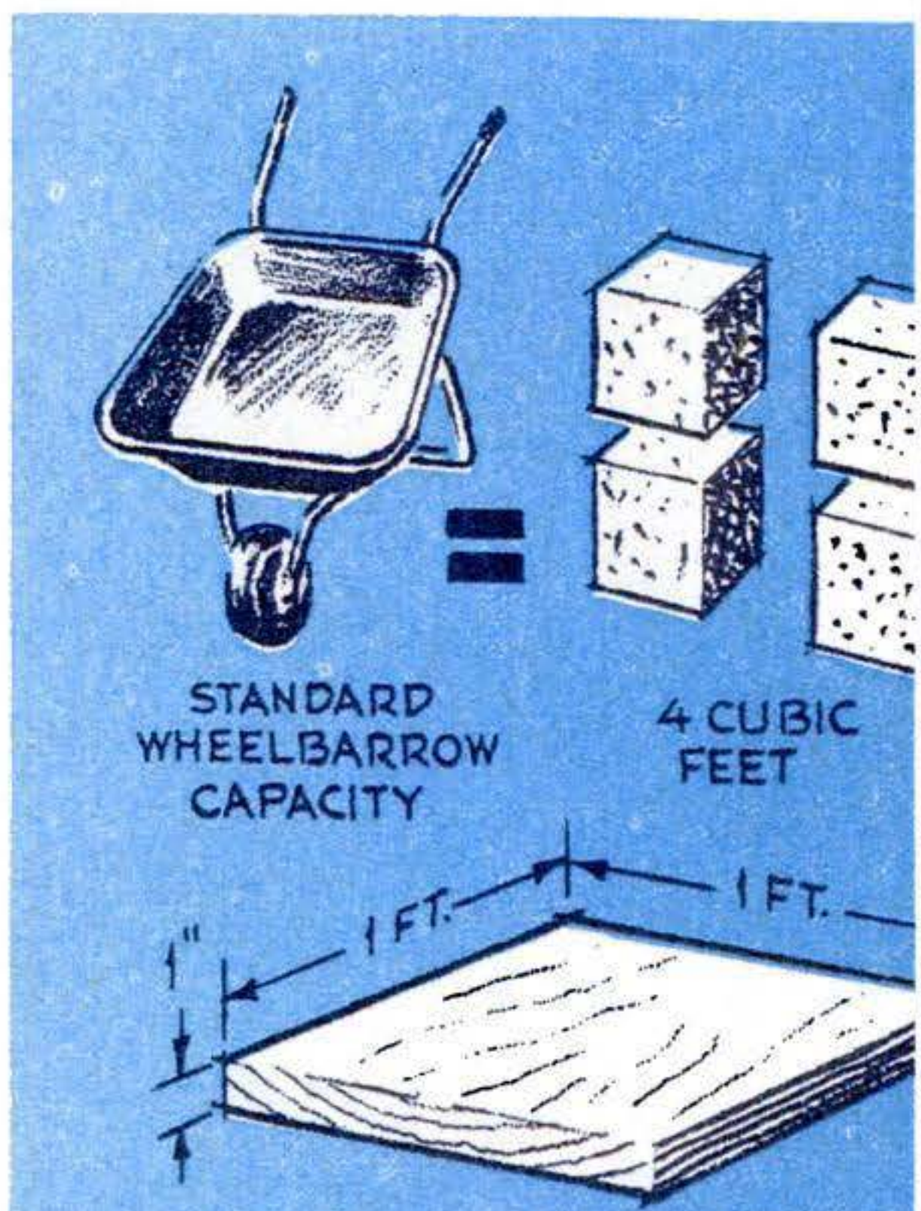
How to figure lumber. The number of board feet in a piece of lumber is simply the square feet (width in feet times the length in feet) multiplied by the number of inches it is thick. But there's one gimmick—if a board is less than 1″ thick, it's still figured as 1″. Lumber prices are quoted by the board foot, or by the hundred or thousand board feet.

Cutting framing costs. Two-by-fours, two-by-sixes, etc., come in standard lengths, starting with 8′ and increasing by 2′ steps. When you need odd-foot lengths, don't order the next even-foot size. Instead, order lengths that you can saw into two or more odd-foot lengths.

Where short two-by-fours are needed, another way to cut costs is to use the less-than-8′ leftover lengths stocked by most lumberyards.

How to figure flooring. To estimate the amount of hardwood flooring you'll need for a room, multiply the length by the width to get the number of square feet of floor area. Then check the first column of the table at right for the size of strip flooring you plan to use. Note the corresponding percentage listed in the second column. Increase the number of square feet of floor area by this percentage and you have the number of board feet of flooring required, including an allowance for wastage.

To estimate tile flooring, find the square footage of the room and multiply by four to determine how many 6″-by-6″ tiles you'll need, or by 16/9 for the number of 9″-by-9″ tiles. If you tile diagonally, add 4″ to both room dimensions when figuring square footage.



Hardwood Floori

Strip-Flooring Dimensions	Add to t Floor Ar
25/32″ x 3¼″	27%
25/32″ x 2¼″	36%
25/32″ x 1½″	53%
½″ x 2½″	23%
½″ x 2″	40%
⅜″ x 2″	28%
⅜″ x 1½″	36%

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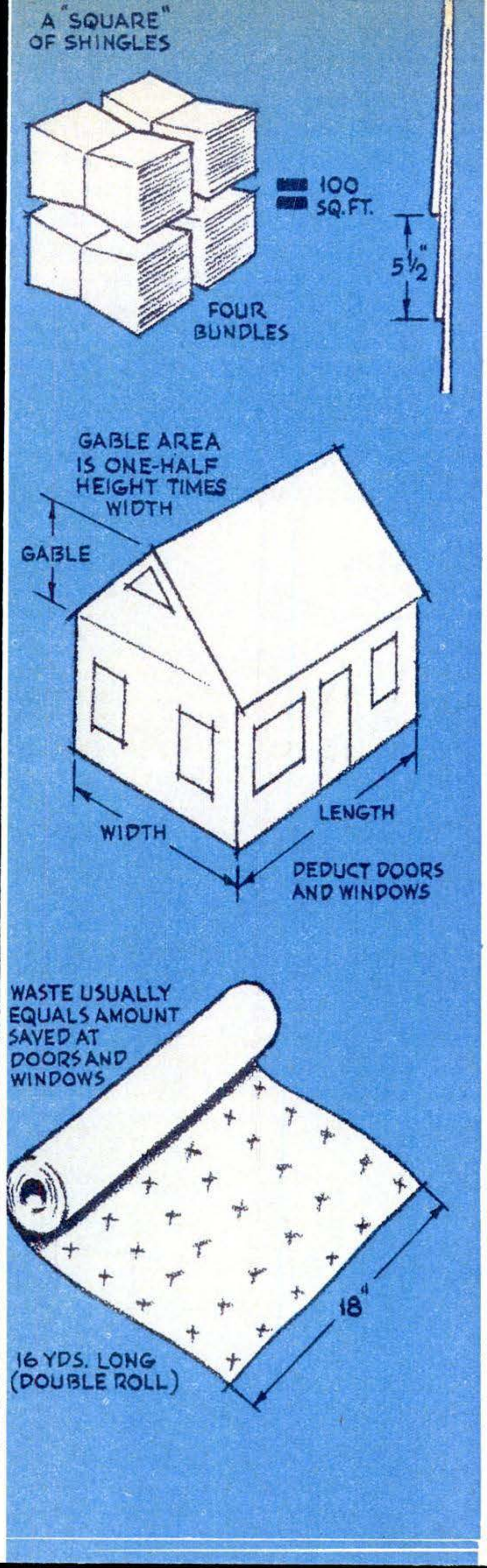

Estimating cedar shingles. The standard unit of packing for cedar shingles is a "square"—which means 100 square feet of roof when used in a particular way. Four bunches of 16″ shingles make a square—or cover 100 square feet when exposed 5″ to the weather. A four-bunch square of 18″ shingles covers 100 square feet, 5½″ to the weather. A three-bunch square of 24″ shingles covers 100 square feet, 10″ to the weather.

How much paint? When painting the exterior of a house, figure the number of square feet of area to be covered. (For a gable, multiply the width at the base by the height, and divide by two.) Subtract door and window areas. Add 10 percent to any area covered by narrow lap siding, 20 percent to any that is unusually rough or porous, 30 percent if corrugated. For the first coat on concrete blocks add 50 percent.

Multiply your final figure by the number of coats you intend to put on, then divide by the manufacturer's square-feet-per-gallon coverage figure. When this figure isn't available, divide by 500 to get the minimum number of gallons you'll need.

How much wallpaper? Although wallpaper is calculated on the basis of single rolls, it is actually sold in what are called double rolls 16 yards long and 18″ wide.

For a quick figure on the number of rolls needed for a room, measure the distance around the room in yards and multiply by two to get the number of strips needed. Then measure the strip length you'll need and divide 16 yards by this to see how many strips you can get from a roll. Divide the total number of strips by this to find out how many rolls you will need. Savings at doors and windows usually allow for wastage.

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Capacity

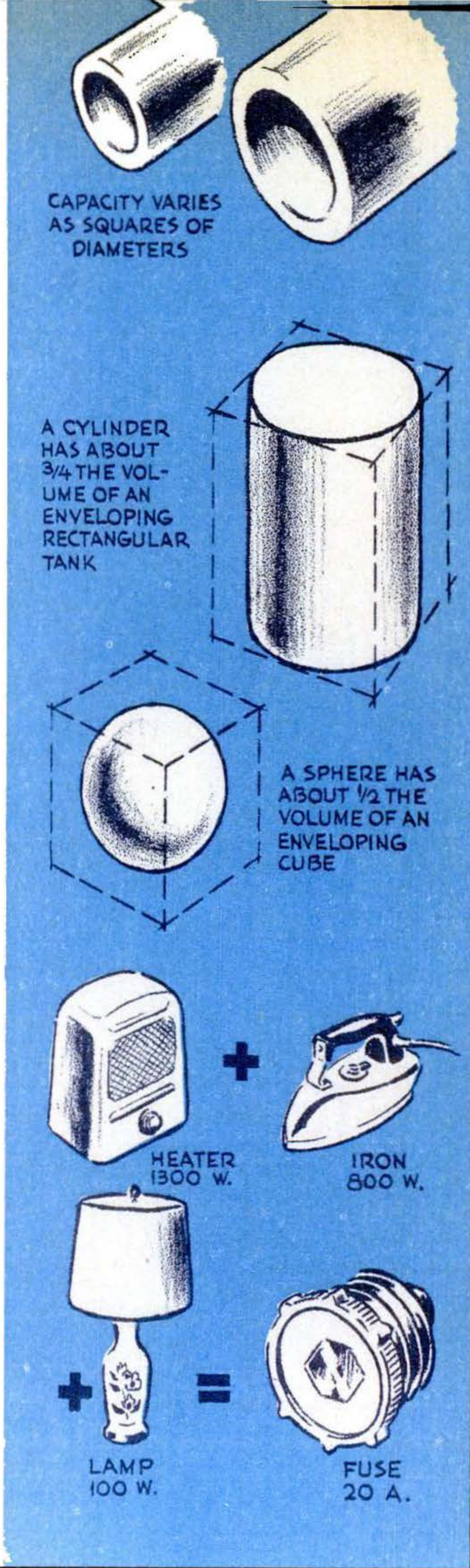
How big a pipe? How much flow a water pipe will deliver depends upon more than its inside diameter. (Pressure, pipe length, and lift are also involved.) But you can quickly compare the capacities of any two pipe sizes if you remember that they vary as the squares of the diameters. That's why pipe with a 1½″ opening will deliver more than twice as much water as 1″.

Cylindrical tank capacity. Remember that a circle has approximately three-fourths the area of a square drawn around it, plus five percent of this figure. Multiply this total by the height or length of the tank in like units of measurement to get the volume. Convert to cubic feet and multiply this figure by 7½ (there are approximately 7½ gallons to a cubic foot).

Spherical tank capacity. A sphere has approximately half the volume of a cube drawn around it, plus five percent of the figure arrived at. Again, multiply the cubic footage by 7½ to get gallons.

Fuse sizes. Inspect your fuses with these general rules in mind. A circuit to which permanent lighting is connected usually has No. 14 wire and should be protected by a 15-amp fuse. An appliance circuit for plug-in receptacles will usually not have wire larger than No. 12, and should be protected by a 20-amp fuse. Don't use 30-amp fuses on such circuits.

Circuit loads. Can you add an electric heater to one of your house circuits? Add wattages of all lights and appliances on the circuit to the heater wattage. Divide by 110 to find the amperage that will be drawn.



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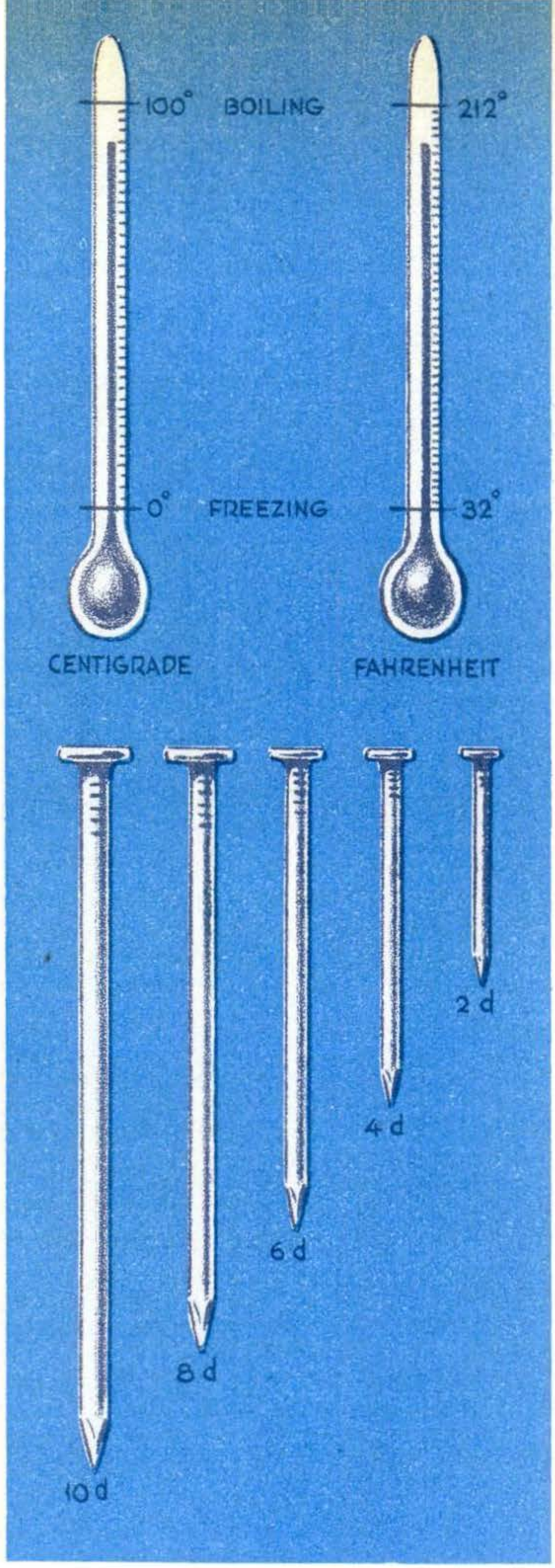
Conversion



Fahrenheit and centigrade. The freezing and boiling points of water are at 32° and 212° on the Fahrenheit scale, but at 0° and 100° on the simpler centigrade.

To change a centigrade reading to Fahrenheit, multiply by 9, divide by 5, then add 32.

Change Fahrenheit to centigrade by reversing that process. Just subtract 32, multiple by 5, then divide by 9.

There's just one temperature—minus 40—at which centigrade and Fahrenheit scales read the same. You can prove it, using either conversion method above. (Nine times minus 40 equals minus 360. Minus 360 divided by five equals minus 72. Minus 72 plus 32 equals minus 40.)

Nail sizes. These are pretty arbitrary, but the smaller nails fall into a pattern that can take the strain off your memory. Divide the penny size of a nail by 4 and add ½″ to get its length in inches. Or subtract ½″ from the inch length of a nail and multiply by 4 to get its size. Thus an 8-penny (8-d) nail is 2½″ long (8÷4=2; 2+½=2½.)

But remember this works only for nails up to 10-penny (10-d) or 3″.

Making a weaker solution. You often need to change a strong solution to a weaker one, particularly when working with acids. Here's the formula: Multiply the amount of solution you have by its strength in percent. Divide this by the percent you want. Subtract the amount of solution you started with. The result is the amount of water to add.

Example: To turn 16 ounces of 50-percent solution to 28-percent, 50 x 16=

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800. Divide this by 28 and subtract 16. This gives you 12.57—the number of ounces of water to add.

One important caution: Don't *add* water to sulphuric acid. Add sulphuric acid to the water.

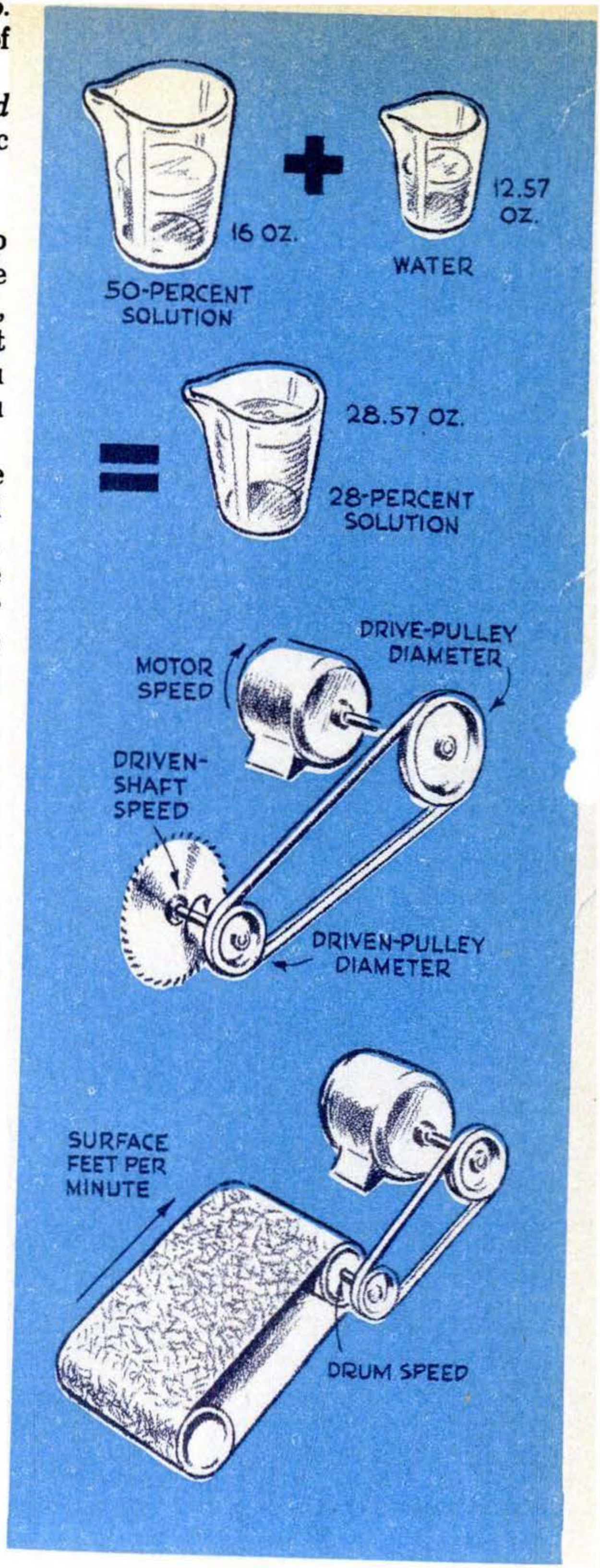
What pulley size? When stepping up or reducing speed with pulleys, you're dealing with four factors: motor speed, drive-pulley diameter, driven-shaft speed, and driven-pulley diameter. You know three of these factors and you want to find the fourth.

This is the way to figure it: Take the pulley of known diameter and speed (this may be actual or desired speed). Multiply speed by diameter and divide the result by the known diameter *or* speed (again, actual or desired) of the other pulley. The result is the missing figure.

For instance: Your joiner has a 2½″ pulley and you want it to turn at about 4,200 r.p.m. What size pulley should you put on your 1,725-r.p.m. motor to run the joiner at that speed?

Multiply 4,200 by 2½, then divide by 1,725 and you get just over 6. Using a 6″ pulley on the motor shaft will do the trick for you.

Surface speed. Revolutions per minute often must be converted into surface feet per minute to give you the recommended speed for a sanding drum or sanding belt (too high a speed will scorch the material). Knowing the desired surface feet per minute, you can determine the required r.p.m. for the drum or the driven drum on a belt sander. Divide the surface-feet-per-minute figure by the drum diameter in inches multiplied by .262. Once you have the r.p.m. figure, use the preceding pulley formula to get the required belt-drive ratio.



P.S. EXTRA: YOUR TEAR-OUT BOOKLET NO. 6

To remove this booklet, place your left hand on the facing magazine page, grasp the booklet with your right, and pull it gently away.

After reading, file for future reference. You'll find it valuable on many home jobs.

December 1957
POPULAR SCIENCE

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6 Tricks with Drawer Knobs

1 Use them as feet. Small wooden knobs available at hardware and dime stores can be used as ornamental feet for small cabinets and boxes. Remove the screw and glue each knob in place. Sand a flat on the knob if it is overly rounded.

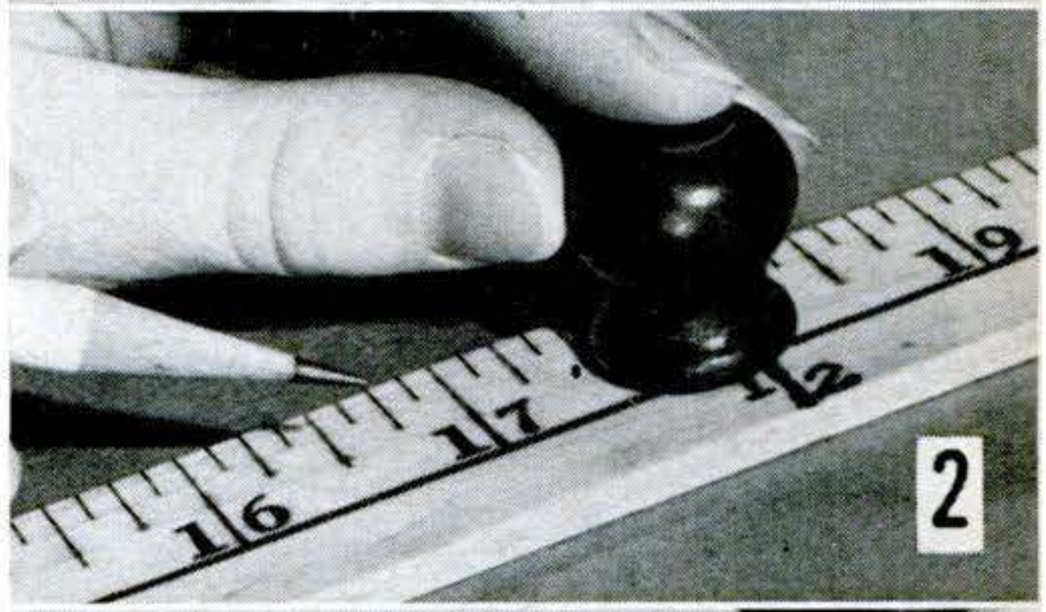
2 Need a yardstick handle? Picking up a yardstick off glass or other smooth surfaces is tough on fingernails. It won't be if you attach a small knob.

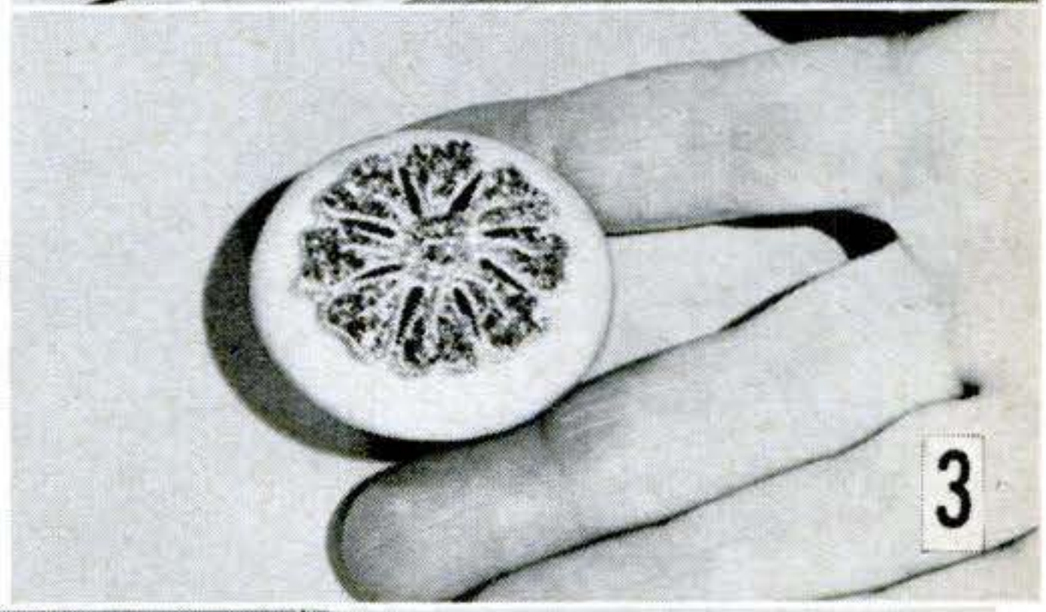
3 Glamorize them. Add a sparkly touch to the drawer knobs of a dresser being built or refinished for a girl's room by gluing a dime-store glitter button to each.

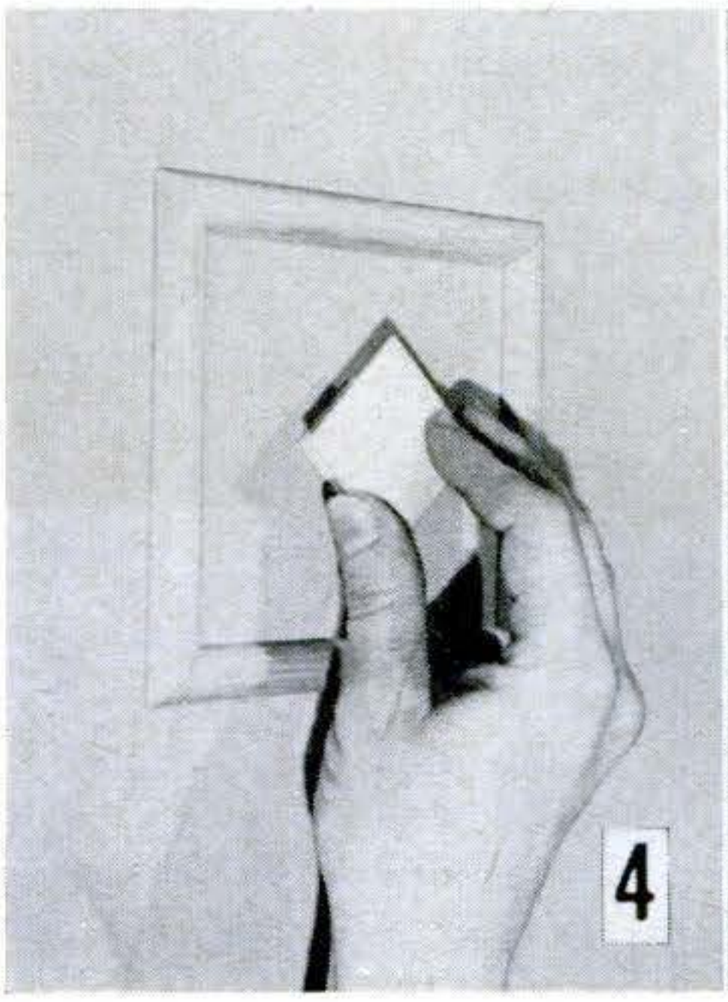
4 Frame them. Knob too small for a large expanse of cabinet door or drawer? Frame it with half-round molding to save the replacement nuisance.

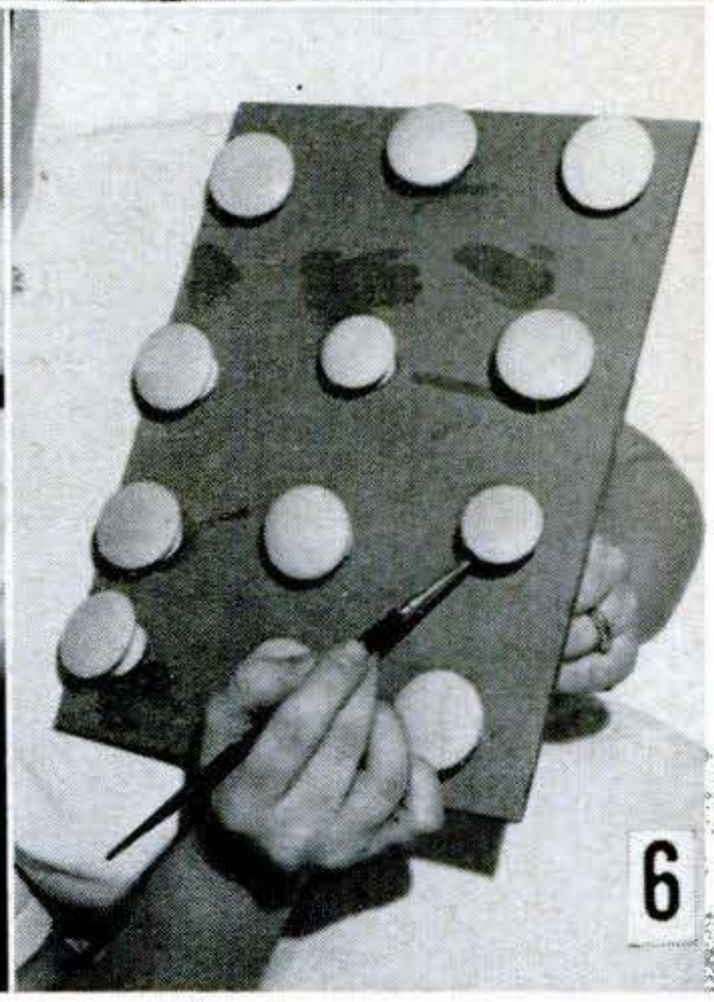
5 Back them up. Painted washers or sheet-metal disks mounted behind wooden knobs keep drawers from being scarred by fingernails when they're being opened, and add a decorative touch, too.

6 Painting is easy. Fasten knobs to a cardboard and the job is a cinch.









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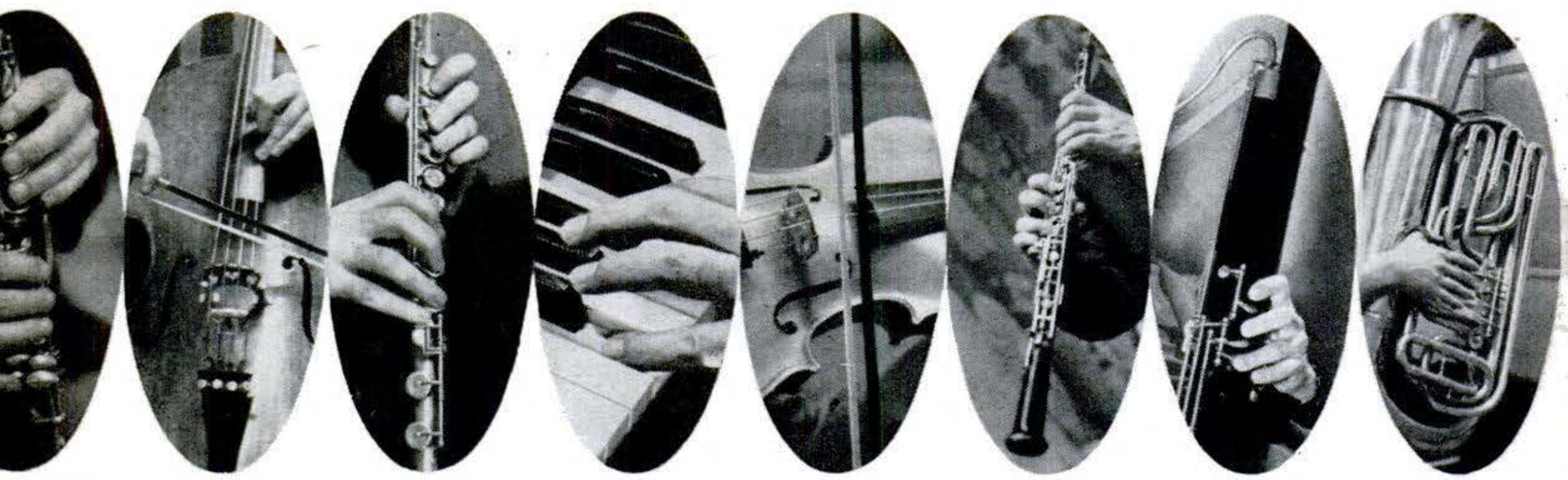
New Record Tests Hi-Fi Systems With Music

• Last January POPULAR SCIENCE introduced a high-fidelity test record. The response was enthusiastic. Nearly 50,000 were sold and it is still a popular item in record stores all over the country. Now the editors have developed a second record to complement the first. This article tells you what it is and what it will do in testing and upgrading a hi-fi system.



CLARINET CELLO FLUTE PIANO VIOLIN OBOE BASSOON TUBA

By Hubert Luckett

NO MATTER how much expensive equipment you have, the practical test of any hi-fi system is the way it gives out with real music. You can make that test with the Popular Science Test Record, Volume II. It's called "True Sounds of Musical Tones."

Right now your hi-fi system may be free of bugs. But there's a compelling reason for having a test record such as this handy. Unless a hi-fi outfit gets regular tune-ups, its performance will probably slip—maybe so gradually that your ear will hardly notice.

But the new record is something more than just a test for telling how good your rig is. It is practical, too. It can:

- Improve the system you have now.
- Help you buy new equipment.
- Show you which component to replace next if you are in process of upgrading your outfit.

A manual that comes with it shows how to use the record for specific tests. It explains what's behind many of the characteristics that make up a good high-fidelity system. To make the tests, all you need is a pair of attentive ears.

To start with, the test for your set's frequency range—particularly its response to the growling low notes—will also test the optimistic performance claims you read in the ads. You'll find that really low bass reproduction is ex-

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It checks transient response and dynamic range

These determine crispness and contrast in your sound. The record can find a fault and trace it to its source

It explores the personality of orchestral instruments

Different instruments, played solo and in orchestra, demonstrate their distinctive sounds

TRUMPET

BASS TROMBONE

FRENCH HORN

It tests bass response with actual music

Using a special technique, musical instruments help you measure the useful low-end response

It shows how the high frequencies give realism to music

Without the highs, a group of instruments will sound alike. Calibrated filters are used to check the upper limits of your hi-fi

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pensive, and that plenty of high response may be cheap but does not necessarily give you musical realism.

Dynamic range, the contrast between loud and soft sound, gives music excitement and variety. Controlled variations on the test record in recording the same music provide you with a positive check on this quality.

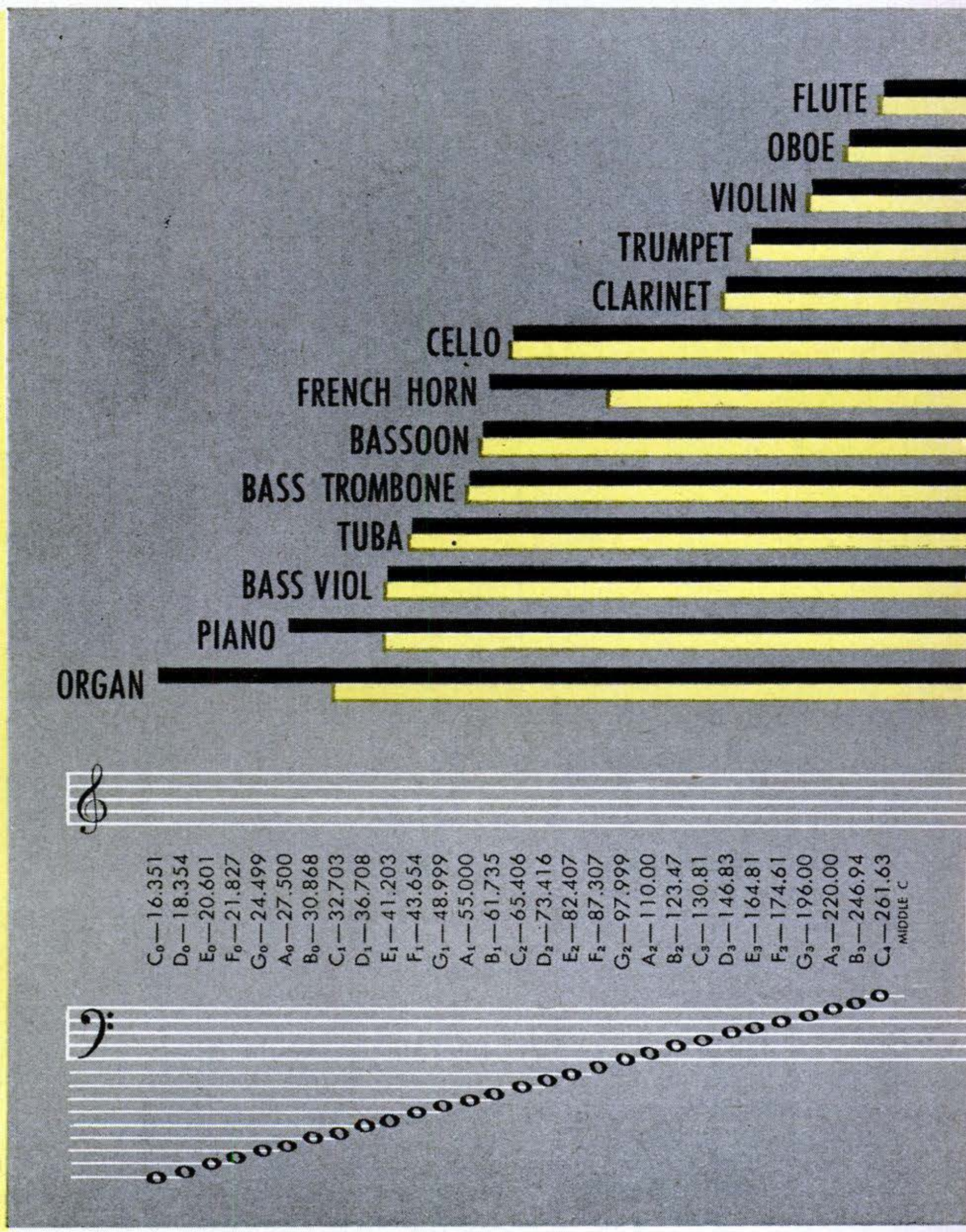
You can also check transient response —the ability to start and stop sudden impulse sounds cleanly—in ways that will help you pinpoint any offending part.

There's a bonus with this record, too. Besides the technical tests, there are solos by 11 different instruments, excerpts from orchestral recordings, and some of the liveliest percussion sounds you've heard.

Frequency range: This is the characteristic most often plugged by hi-fi salesmen. They give you the pitch that their particular equipment covers a frequency spread "from 20 to 20,000 cycles." But even for the most elaborate outfit that claim rarely describes the range of sounds you actually hear.

Frequency Ranges of Musical Instruments

INSTRUMENT SOUNDS used in the new PS test record are represented in the chart to the right. The black lines show the range of fundamental tones. The colored lines show the range of frequencies your system must cover if it is to reproduce, without audible difference, the live sound of the instrument. With the PS record, you will hear how closely your rig approaches this ideal.



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Now the hi-fi salesmen and magazine ads may be absolutely honest in referring to a signal that can be detected at extremes of 20 cycles and 20,000 cycles. But to you as a buyer, the important point is: How much will you hear at a satisfactory volume and with musical effect?

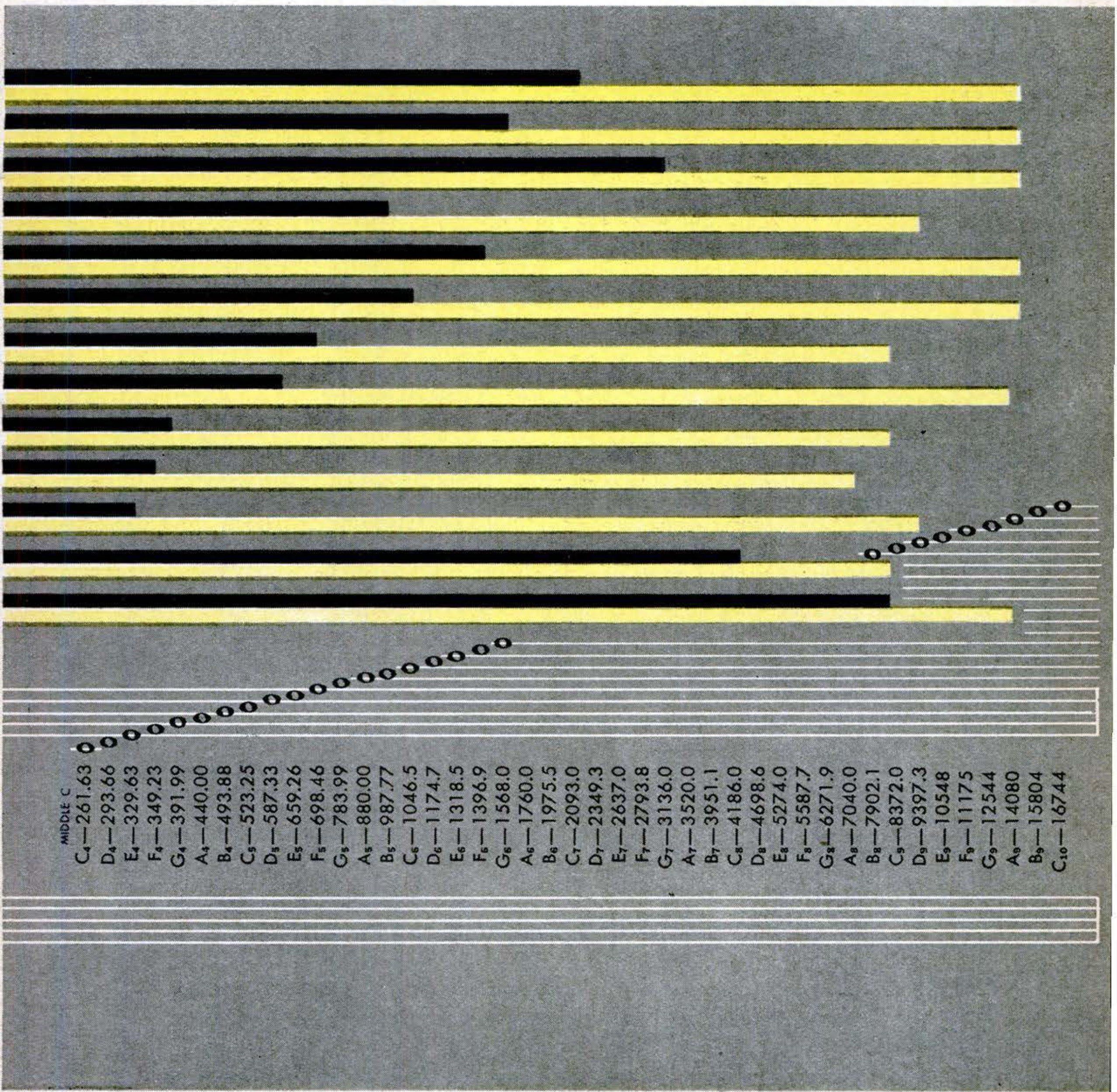
The new POPULAR SCIENCE record lets you decide two crucial questions for yourself: How much range do I really need? What will my outfit actually deliver? You'll find the answers by testing for response at the low and high ends.

The low (bass) frequencies come first. These are the most difficult, equipment-wise, to reproduce. When you spend over $300 for hi-fi gear, most of the additional money goes for improvement here.

The PS Test Record checks out bass response by having each musical instrument play alone, and run down the scale to its lowest note.

You hear each note twice. The first tone is for reference. It is a superbly accurate recording of the instrument's sound. For the second sound, frequencies below 120 cycles are blocked by a filter.

The two side-by-side tones will thus



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At the studio: recording date

HOW IT WAS DONE: The PS Test Record, Volume II, was recorded at Reeves Sound Studios in New York. Fairchild tape recorders and a single Telefunken mike were used. The original lacquer master discs were cut on a Hydrofeed lathe. From this, nickel stampers were made. Pressings are done by Urania Records in limited runs: 500 records per stamper. That's PS Technical Editor Luckett with the hand mike, supervising the recording. Engineer Jack Matthews of Reeves is at the controls.

sound identical until they pass the filter's cut-off point. After cut-off, you will hear a distinct difference between the two tones *only* if your rig can reproduce at full volume below 120 cycles. The more difference you hear, the better the response you are getting at that particular bass tone.

This test is repeated with different instruments, and also with a 65-cycle cut-off filter.

The filtered tone simulates the performance of a speaker that begins to lose output below 120 cycles. If the two tones sound alike below that frequency, then your speaker is falling off in output about the same way the filtered tone has been caused to do in the recording.

Although the filter, or your speaker, blocks out the low, fundamental part of the tone, you still hear what you *think* is the proper note. The reason is partly in the nature of musical tones and partly a trick of your hearing.

A note from a musical instrument has a fundamental frequency, which determines pitch, and a series of overtones of higher frequencies. The filter used in the test cuts out the low tones but lets the higher overtones pass through. The result is that your ear imagines that it hears

[Continued on page 228]

How to Order Popular Science Hi-Fi Test Record No. 2

The new disc, "True Sounds of Musical Tones," is available to PS readers at a prepublication price of only $2.50 for one, $4 for two, directly from Magazine Services, Inc. But order by Jan. 31. The price will go up Feb. 1 to $3.50 for one, $5 for two (still a special price for PS readers).

Hi-Fi Test Record No. 1 Is Still Available

You can still get the popular Test Record No. 1, which 50,000 readers of Popular Science have used effectively. It features sweep frequencies, sine-wave tests, tones for tuning speaker enclosures, a sound-effects quiz. The price (special to PS readers) is $3.50 for one, $5 for two.

To Order *Send cash, check or money order to Magazine Services, Inc., Dept. 1257, 104 E. 26th St., New York 10, N.Y. Local record stores that carry Urania records will also have them, at higher prices.*

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A grease job covers major points, but how about those squeaks that remain? To get rid of them, try:

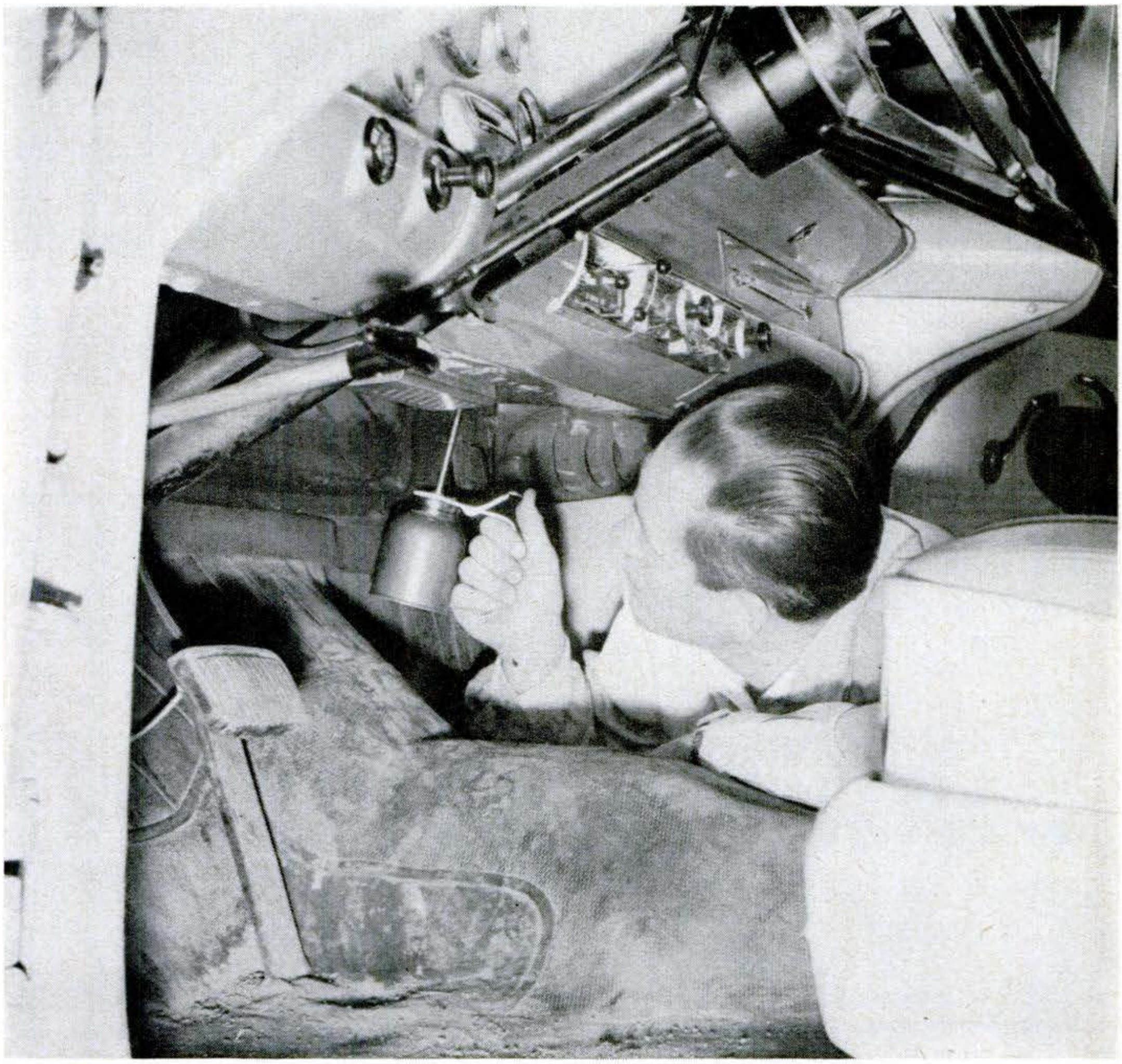
Auto Upkeep

Lubing the Spots the Grease Man Misses

By E. F. Lindsley

WHEN you splurge on a dollar-and-six-bit grease job you probably get your money's worth of high-pressure gunning at the running-gear fittings, and a quick check on the drive-line gear boxes. But your grease man is one in a hundred if he bothers to hand-feed the dozens of little friction spots that hide in a car's dark corners.

These dry and chafing small fry are as



ONE FRICTION SPOT the grease man seldom troubles to lube. Yet binding heater and ventilator controls can cause distraction when you're on the road. Oil the pivot points and cables.

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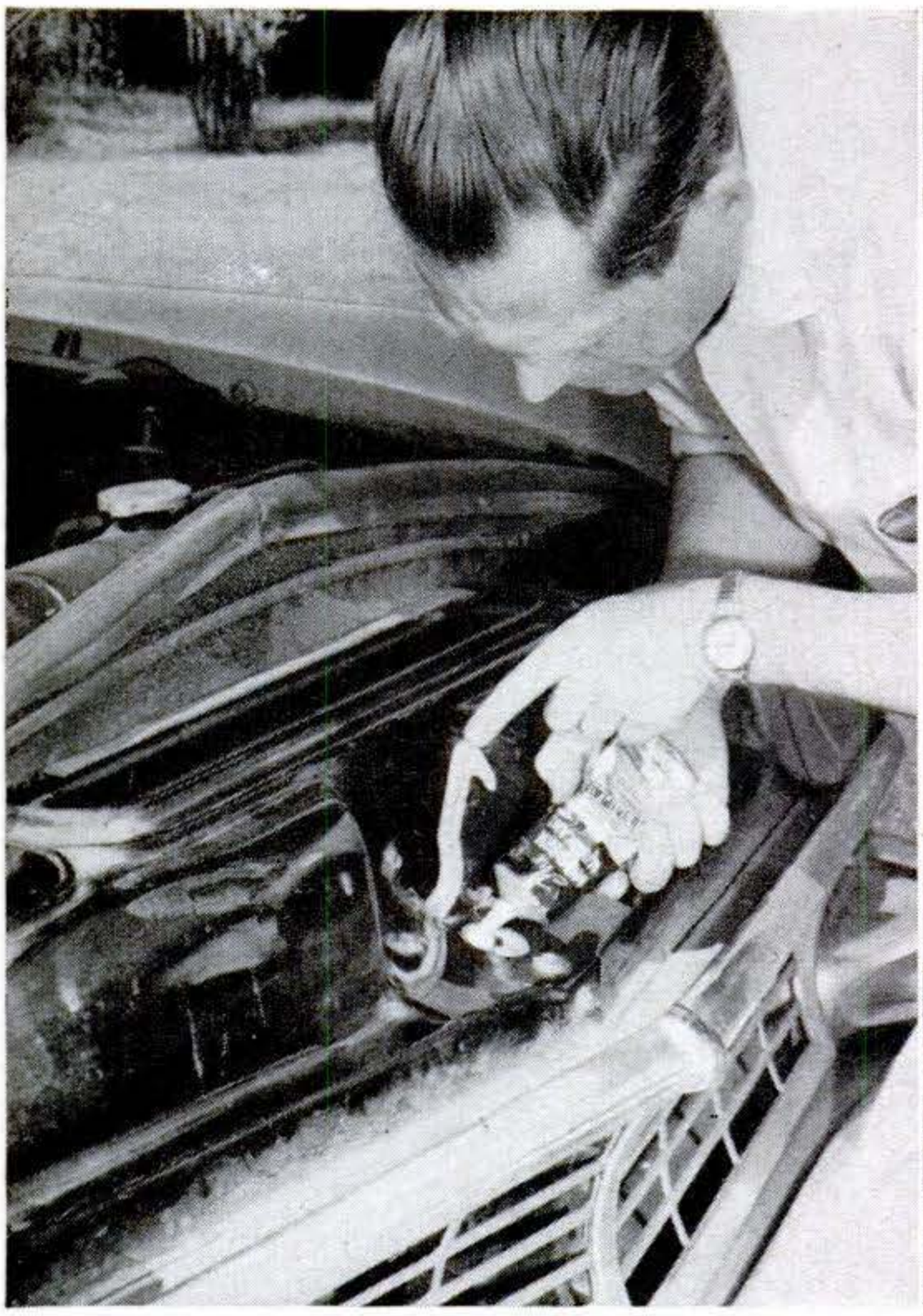
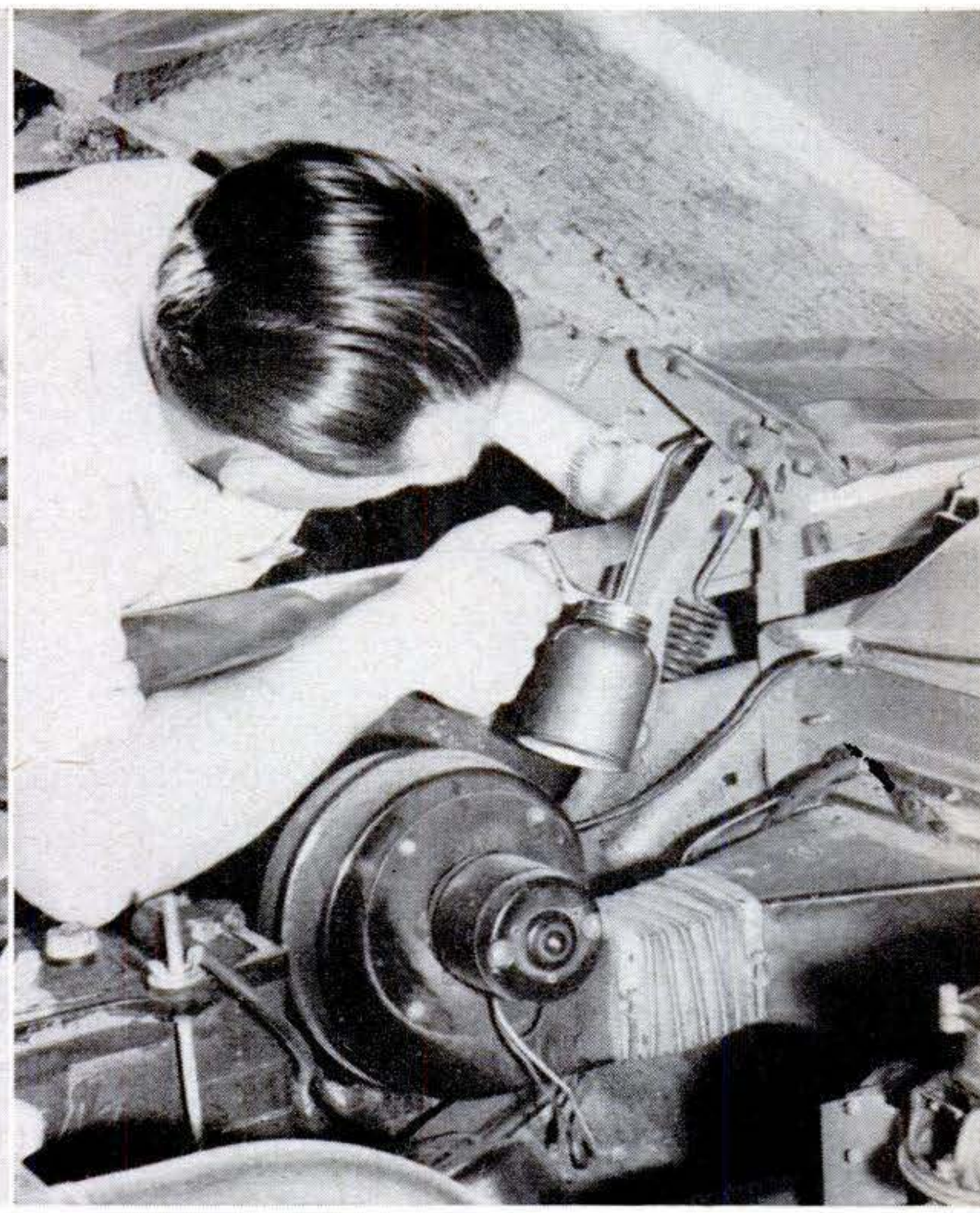
How to frictionproof a hood

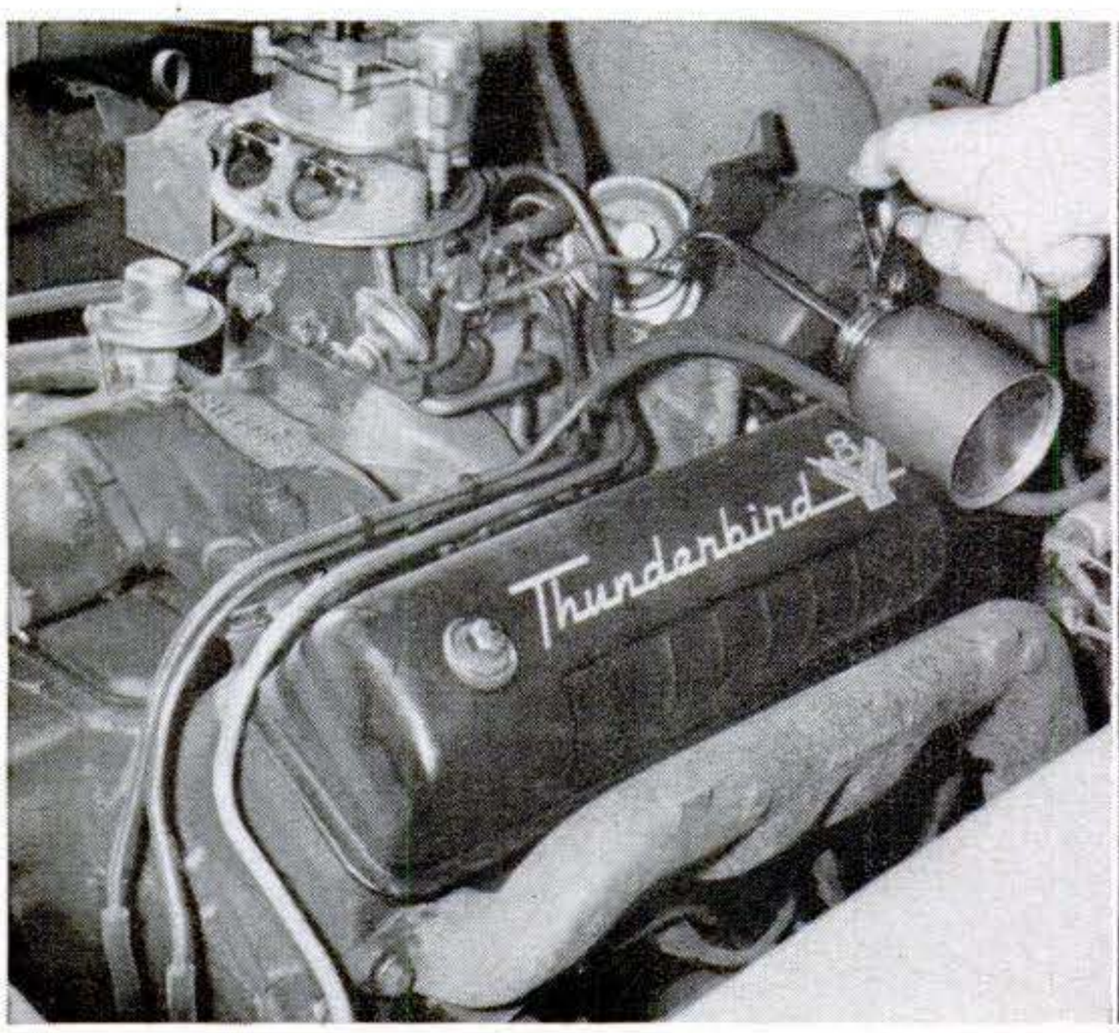


TAKING FIGHT OUT OF THE HOOD: It will open easily and close securely if you (1) clean accumulated dirt and rust from the latch and release mechanisms; (2) apply 10-W oil to the moving parts, dabs of light grease to the striker.

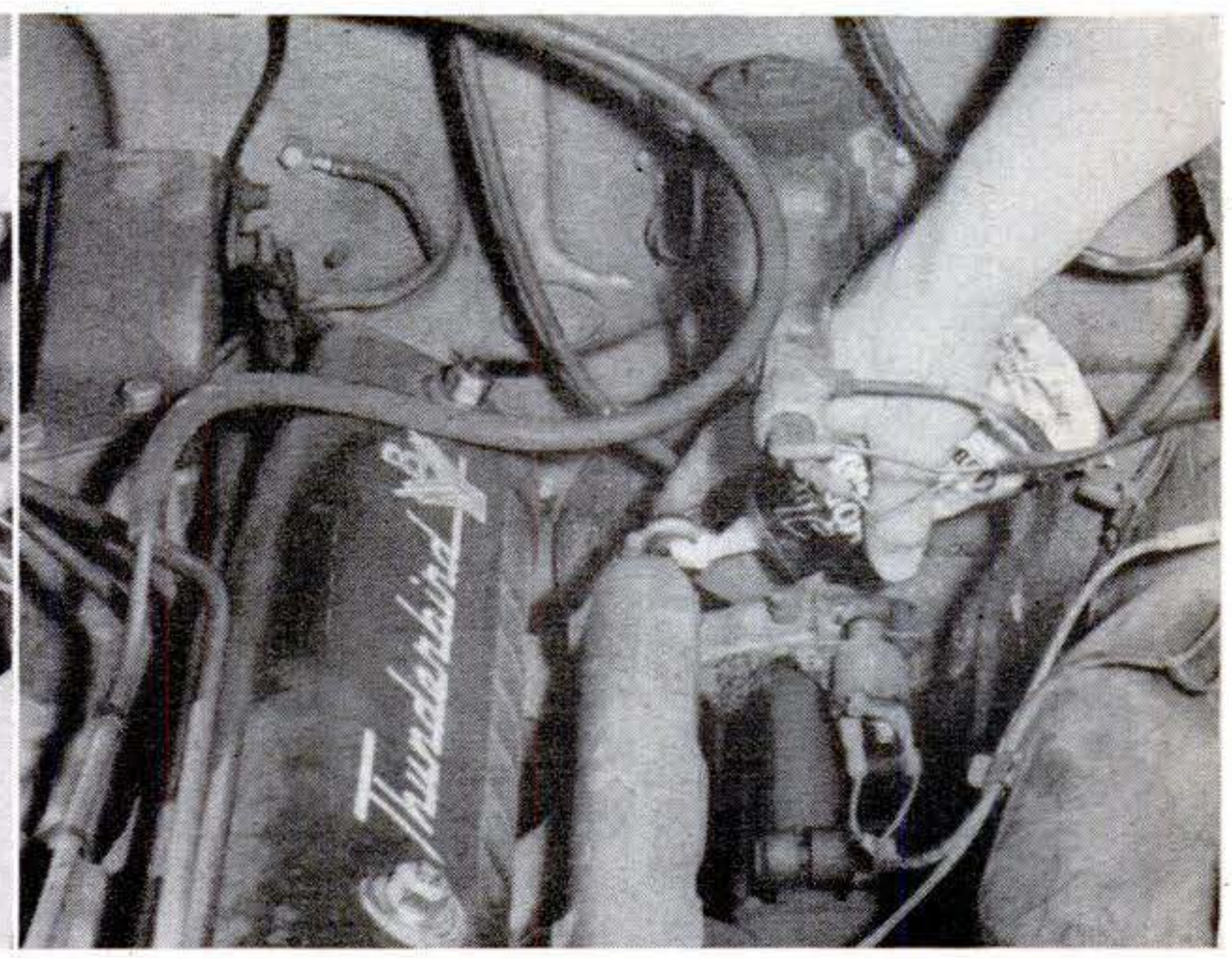


LUBE THE HINGES, TOO, with a few drops of oil at pivot points (this goes for trunk-lid hinges as well as those beneath the hood). A long-nosed, pump-type squirt can filled with light oil is handy for reaching such trouble spots.

In the engine compartment



FREE-WORKING THROTTLE and consistent idling speed that prevents "stop-light creep" are insured by clean and oiled linkage. Stickiness here often prevents a return to full idle, also makes a car seem heavy-footed on the road.



TRANSMISSION CONTROLS, both manual and automatic, can usually stand cleaning and lubricating. Oil tends to deteriorate rubber bushings. If the bushings are worn, or soft and gooey, you can replace them for a few cents.

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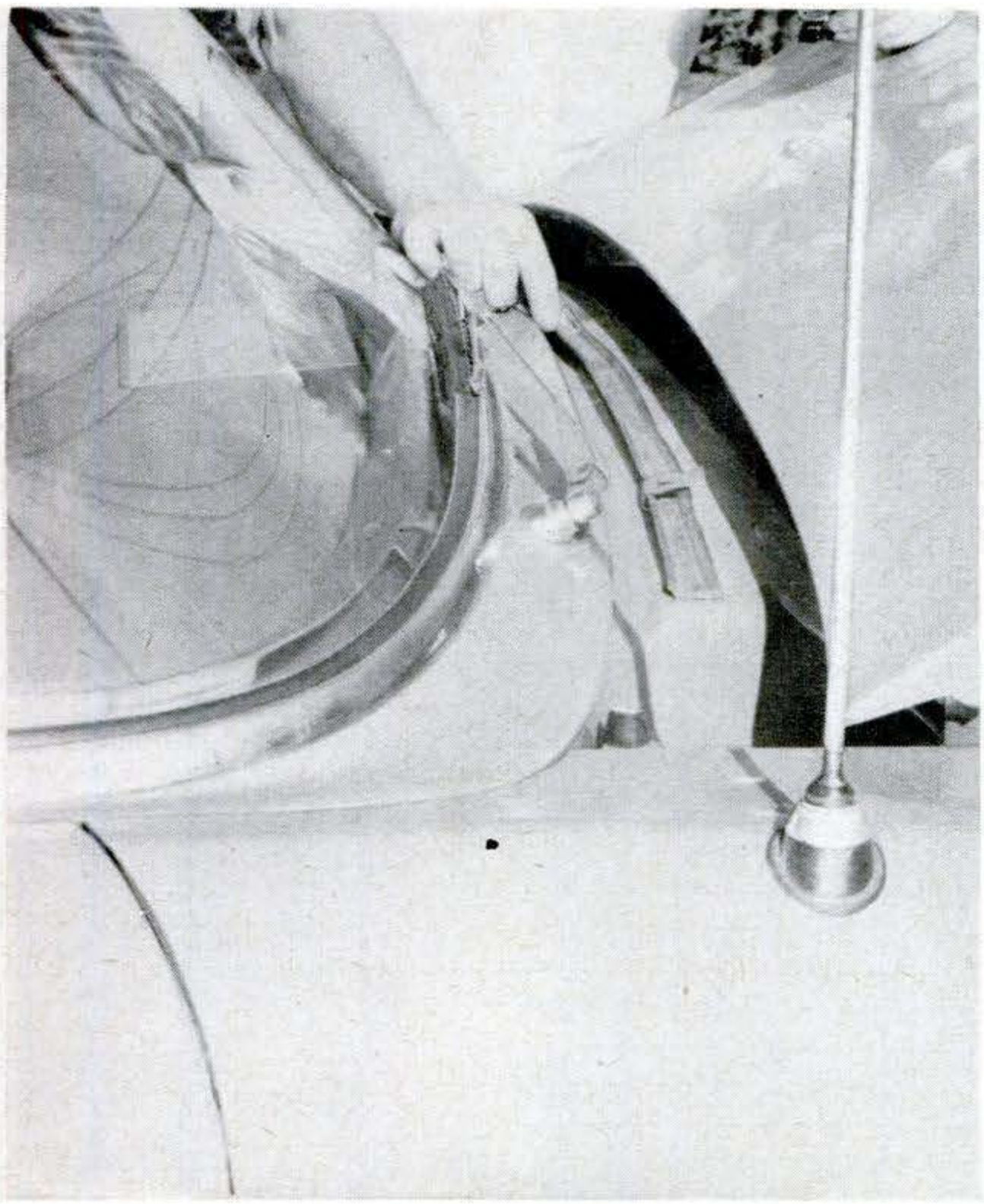


RUBBER HOOD-SEAL STRIP may cause odd popping and squeaking noises due to slight movements of the hood. The treatment for this and other chafing rubber parts is stainless stick lubricant, or a once-over with brake fluid.

common to models just off the assembly line as they are to the 100,000-milers. They take the form of hard-to-crank windows, stubborn heater and ventilator controls, balky hood releases, and fingernail-splitting glove-compartment latches. They announce themselves with irritating squeaks and groans that harmonize like a pondful of frogs. One, you could live with. But collectively they can add up to a din that takes the joy out of driving.

You can silence these friction bugs by devoting an hour or so every 2,000 miles to systematically dabbing grease and dribbling oil. You'll find a long-nosed, pump-type squirt can handy for the hard-to-reach spots. Keep it filled with SAE 10-W oil. On broad sliding areas use a light grease of the tube variety. Apply stainless stick lubricant or brake fluid to door and window weatherstrips and rub blocks (never use oil or other petroleum products on rubber).

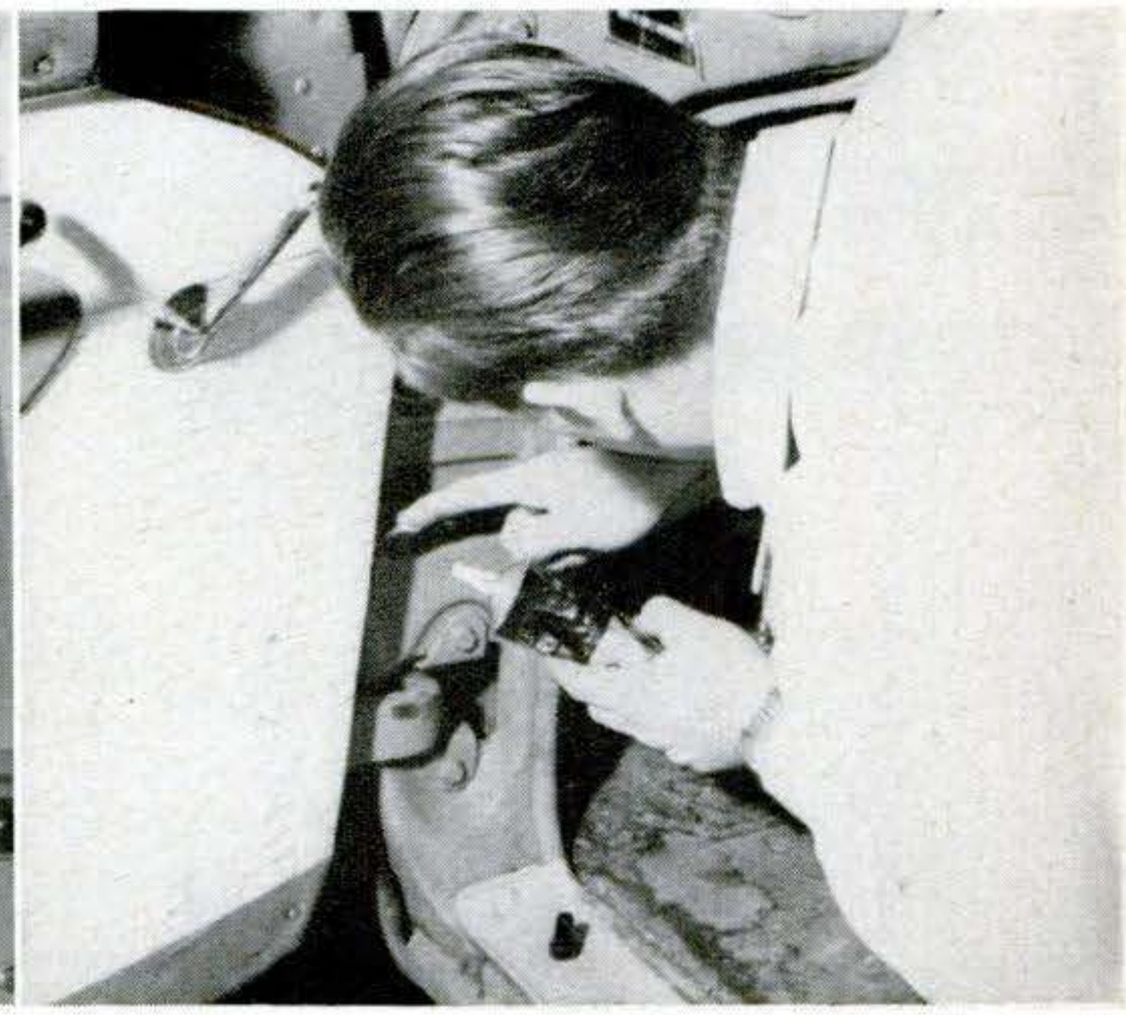
You'll save time and insure a thorough job if you set up an orderly lubing pattern, and stay with it.

Start with the hood latch, hood rub blocks, hinges and other gimmicks it takes to raise and lower the forward hatch cover. Next, have a look at the accelerator linkage, and the transmission controls.

With these cleaned up, go after the

The right treatment for doors and windows

STIFF WINDOW ACTION may be caused by internal troubles that are best left to a body-repair shop. But high friction in the seal-strip grooves at sides is more likely to be the culprit. Oil, worked into the felt, does wonders here.



EASING DOOR ACTION: Check-straps, dovetails and lock tongues call for light greasing, or applications of stainless stick lubricant. Squirt oil deep back into hidden hinge pins, and apply a few drops to all moving lock parts.

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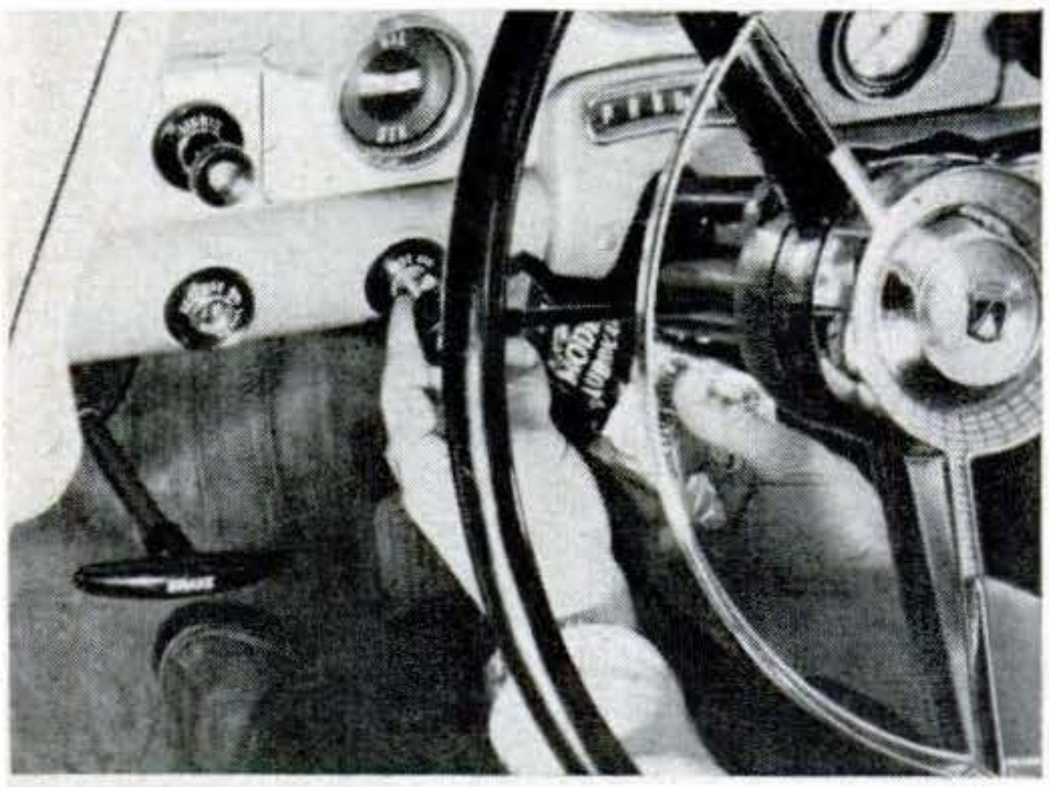
door hinges and locks, and the window guides. Dab a bit of grease on the adjustable front-seat tracks, and lube the push-pull rods on the dash controls. Then check the glove-compartment lock. Finally, give the heater and ventilator pivot points and wires a touch of the squirt can. Easy does it here, or you'll have oil dripping on your new socks come Sunday. You should now have a car on which everything works as smoothly and silently as the door of a bank vault.

Aid for interior controls



HARD-TO-OPERATE DASH CONTROLS respond to a thin coating of grease on push-pull rods.

WORK A LITTLE OIL into the glove-compartment lock. Dab the latch with a touch of grease.

REMOVE SIDE PANELS from adjustable front seat while you're working at floor level. Apply grease to the tracks, oil to the moving parts.

Lubing pattern for minor friction points

PART	LUBRICANT
1 HOOD LATCH (striker)	Light grease
2 HOOD LATCH (moving parts)	10-W oil
3 HOOD HINGES	
4 HOOD SEAL STRIP	Stainless stick lubricant, or brake fluid
5 HOOD RUB BLOCKS	
6 FAN BELT (inner surface)	
7 ACCELERATOR-LINKAGE JOINTS	10-W oil
8 TRANSMISSION-CONTROL JOINTS	
9 TRUNK-LID HINGES	
10 TRUNK LOCK (moving parts)	
11 TRUNK LOCK (striker)	Light grease
12 DOOR HINGE PINS	10-W oil
13 DOOR LOCK (moving parts)	
14 DOOR LOCK (dovetails)	
15 DOOR LOCK (wedges)	Light grease, or stainless stick lubricant
16 DOOR CHECK-STRAPS	
17 DOOR WEATHERSTRIPPING	Stainless stick lubricant, or brake fluid
18 WINDOW-GUIDE STRIPS	10-W oil
19 PUSH-PULL DASH CONTROLS	Light grease, or stainless stick lubricant
20 GLOVE-COMPARTMENT LATCH	
21 GLOVE-COMPARTMENT LOCK	10-W oil
22 HEATER AND VENTILATOR CONTROLS (moving parts)	
23 FRONT-SEAT ADJUSTOR (moving parts)	
24 FRONT-SEAT ADJUSTOR (tracks)	Light grease

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Wonderful Start!

Lesson number one: a new set of ACs can save three times their cost in gasoline

First solo! Great day for any driver . . . and it's a great day when a new set of AC Hot Tip Spark Plugs goes into your car. Here's why: the long, thin, recessed "Hot Tip" insulator heats faster to burn away carbon, oil and combustion deposits. This exclusive AC anti-fouling action assures efficient fuel combustion—saves as much as one gallon of gasoline in ten. In an average year's driving this would pay for a new set of AC Hot Tip Spark Plugs three times over.

ACs are factory equipment on more new cars than any other make. Install new ACs every 10,000 miles!

GM
FORWARD FROM FIFTY

AC THE ELECTRONICS DIVISION OF GENERAL MOTORS

ACTION
starts with

AC

HOT TIP
SPARK PLUGS

Watch Walt Disney Studios' ZORRO every week on ABC-TV

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Gus Bails Out

With Christmas coming and just enough cash to buy his

By Martin Bunn

A HEAVY December snowstorm was in progress when the call from Cynthia Andrews came to Gus Wilson's Model Garage.

"Mr. Wilson," Cynthia Andrews said, relief in her voice, "thank goodness you haven't closed for the night."

"What's your trouble?" Gus asked, hoping that he wasn't going to be called out into a storm like this at seven o'clock in the evening.

"My son George just telephoned me that the car is broken down in the snow. I can't think what might be wrong with it. I used it only yesterday, when I went out into the country to buy a Christmas turkey from a farm."

"Things like that happen," Gus said.

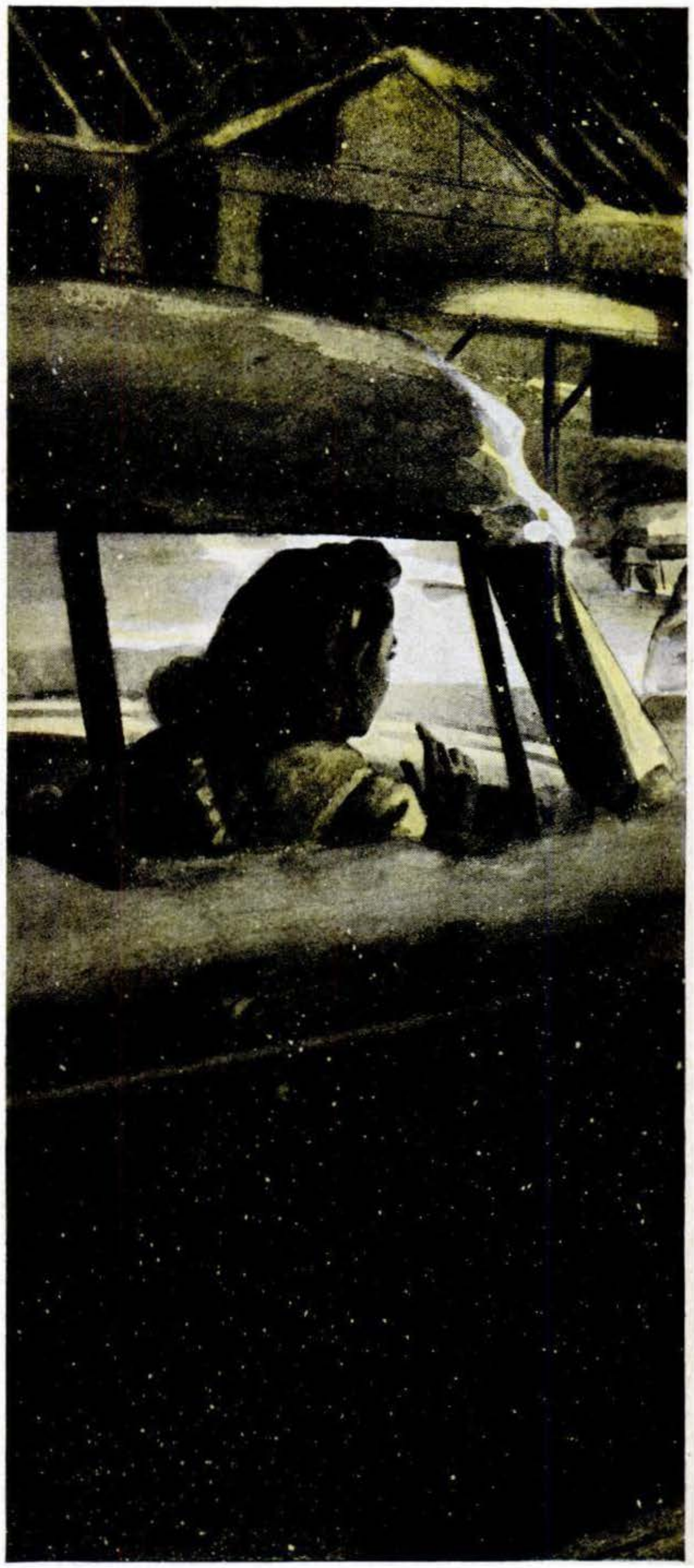
"Maybe I shouldn't have given George permission to use the car," Mrs. Andrews continued. "He's only 17, you know. But it wasn't snowing when he left, and it's only two days to Christmas. George wanted to take his girl friend, Lydia Turner, for a ride, hoping to find out what she would like for a Christmas present."

"Well, Mrs. Andrews," Gus interrupted, "if you'll give me the address I'll get going."

"Address? I don't know exactly. It's somewhere on North 128th Street. Do you know where that is?"

"I'll find it," Gus said grimly and hung up, picturing what it would be like now out on 128th Street, which had been newly bulldozed out of weed-ridden lots, at the very edge of the Meadowville housing development.

"Kids can get themselves into the darnedest jams," Gus said to his helper,



George groaned. "Dad will blow sky-high when he hears about this."

"Maybe not," Gus said. "Let's get rolling."

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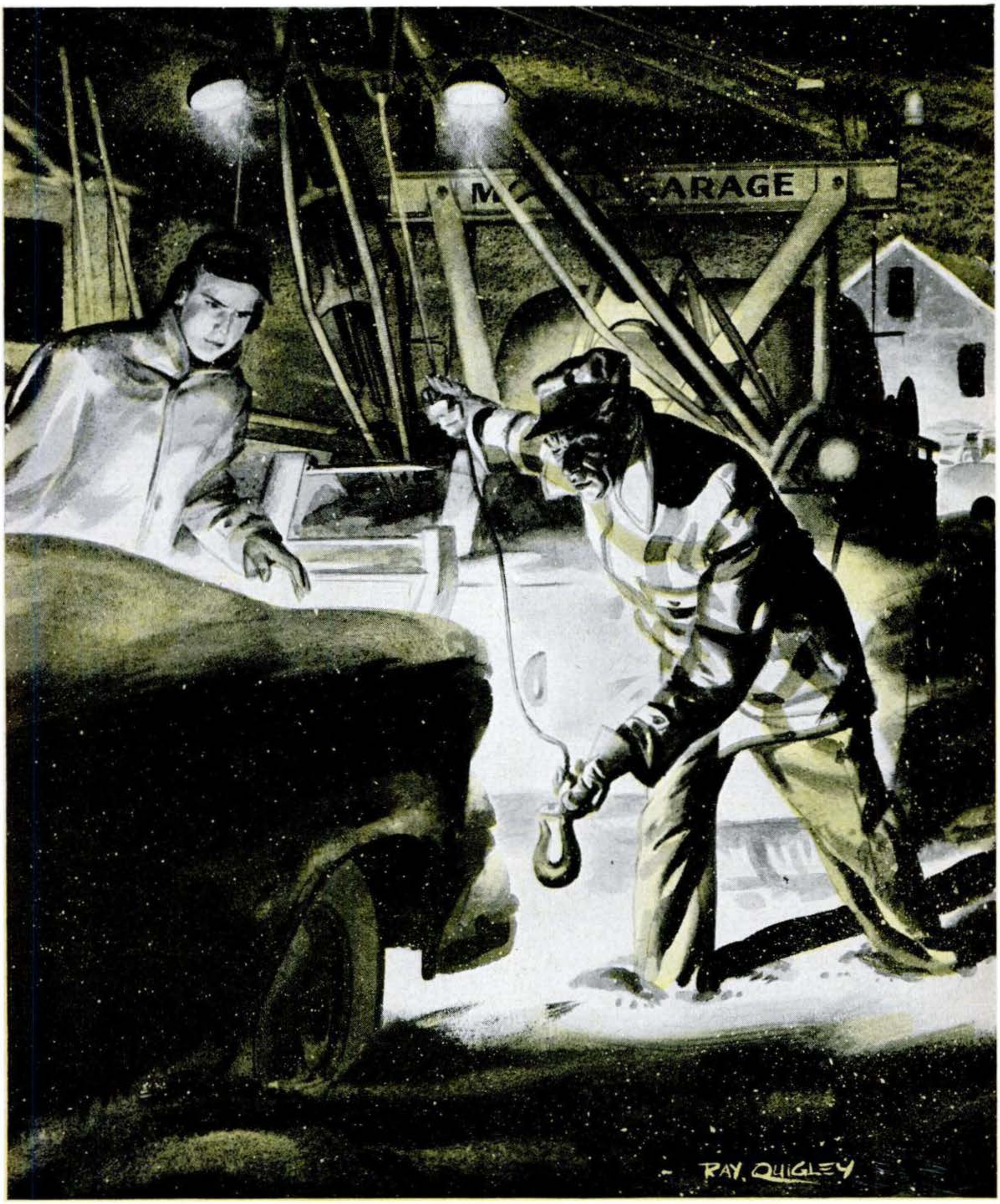
a Teen-Ager

girl a gift, the kid was stuck in more ways than one



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Stan Hicks, as he climbed into his service truck. "Sorry, Stan, but I guess you'd better stick around until I get back. I may need your help."

Gus drove slowly through the swirling snow. As his windshield wipers labored to keep the glass clear, the long rows of newly built houses in Meadowville passed in ghostly procession.

SNOW whipped at Gus's face as he stopped to play his spotlight beam on a street-corner sign—120th Street. He counted the streets as he progressed, finally arriving at 128th, then turned north, hoping that he wasn't already north of the stalled car. He proceeded slowly, sweeping his spotlight back and forth across the thinly graveled thoroughfare, along which houses in various stages of construction stood like rows of snow-clad skeletons.

When he finally spotted the Andrews car it was so snow-blown that at first he took it to be a snowdrift. At his approach, lights snapped on and George Andrews leaped out, waving his arms.

Gus wasted no time. He swung the truck around, backed close, got out and cranked down the winch chain.

"Mr. Wilson!" George exclaimed. "Am I glad to see you!"

"You don't seem to be in deep enough to be stuck," Gus said. "Couldn't you pull out?"

"Sure," George said, "if there wasn't something wrong with the car. It won't pull and there's a grating noise in the rear end."

"Sounds like a stripped differential gear or a broken axle," Gus said. "How come you're way out here on a night like this?"

"I was taking Lydia home. We couldn't see the street signs for snow and drove too far out. When we tried to turn around something went wrong." George groaned. "Dad will blow sky-high when he hears about this."

"Maybe not," Gus said. "Let's get rolling." He stared thoughtfully at the car for a moment. "With rear-end trouble, maybe we'd better play it safe and hook on to the back instead of the front." He moved the service truck around to the rear, attached the winch chain and hoisted the rear end up.

"Okay," he told George. "Here we go."

AS SOON as he got into the Model Garage, Gus telephoned the Andrews. John Andrews, George's father, answered.

"I've pulled your car in, John," Gus told him. "There's something wrong, but I haven't had time to trace it yet."

"Whatever it is, fix it," Andrews said irritably. "But mind you, don't charge it to me. Make the boy pay for it. It's his responsibility. I'll call a taxi and come down there and drive the car home myself."

"Better give me an hour or so first," Gus said, and hung up.

As he raised the rear end of the car on a floor jack, Gus found himself under the scrutiny of two very worried teenagers.

"What did George's father say?" Lydia asked. "Was he very angry?"

"Well—not very," Gus said with a smile. "He'll be down later to drive you home."

"Treating me like a kid again," George declared moodily. "I could drive home just as well as he could."

"Sure," said Gus agreeably. "Now let's see what's wrong."

WITH Stan Hicks easing the car into gear, Gus listened underneath. There was a definite grinding noise, which seemed to come from the differential. The wheels ran jerkily. Gus lowered the wheels to the floor and found that both stopped with the car in gear, motor turning. But now the grinding noise increased in volume. Gus asked himself: a broken axle? Or a stripped ring and pinion?

He jacked the rear end up again. When tests showed that the axles were sound, he settled on the differential gears and pulled the differential housing cover for inspection. What he saw astonished him: The gears were in perfect condition.

"Strange," he mused. "Start the motor, Stan, and turn her over again. Slowly now. That's right. Now put on the brakes."

With the motor turning in gear, the rear wheels locked with the brakes, Gus checked to see if the pinion gear was turning against the ring gear of the differential. It wasn't. The grating noise continued. He ducked under the car, sure now that the grinding sound had been merely telegraphing down the torque tube

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to the differential housing. He ran his ear along the torque tube.

"Aha!" he exclaimed. "It's in the universal joint."

Taking the universal down, Gus saw at last what had happened. The splined yoke, where it fitted over the drive shaft, had split open, causing the splines to jump over each other so that they failed to drive the rear wheels under load.

Gus installed a new universal joint, and the Andrews car was ready to roll.

YOUNG Andrews was at his heels when Gus went into the office.

"I hope this isn't going to cost too much, Mr. Wilson," he said nervously, "so Dad won't hit the roof when he sees the bill."

"Your father *won't* see it, George," said Gus. "He said you must pay it."

"He did!" George groaned again. "Gee, Mr. Wilson, I've been socking away part of my allowance for months now, and I've only enough to buy Lydia's Christmas present."

"I'm sorry," Gus said.

"How much money do you have?"

"Ten dollars."

"That," declared Gus, "is just the amount you owe me."

"Gee," the boy exclaimed, handing Gus some crumpled bills, "now I'm completely broke, and Christmas is only two days off."

Just then the senior Andrews entered the office. "Did you get the car fixed, Gus?" he asked.

"Yes, and George paid the bill."

"Fine," Andrews said. "Well, get in the car, George, and we'll take Lydia home."

"Aren't you interested in knowing what was wrong with your car?" Gus said to the parent's retreating figure.

"Sure," said Andrews, pausing. "What did George manage to break this time? And how much did it cost him?"

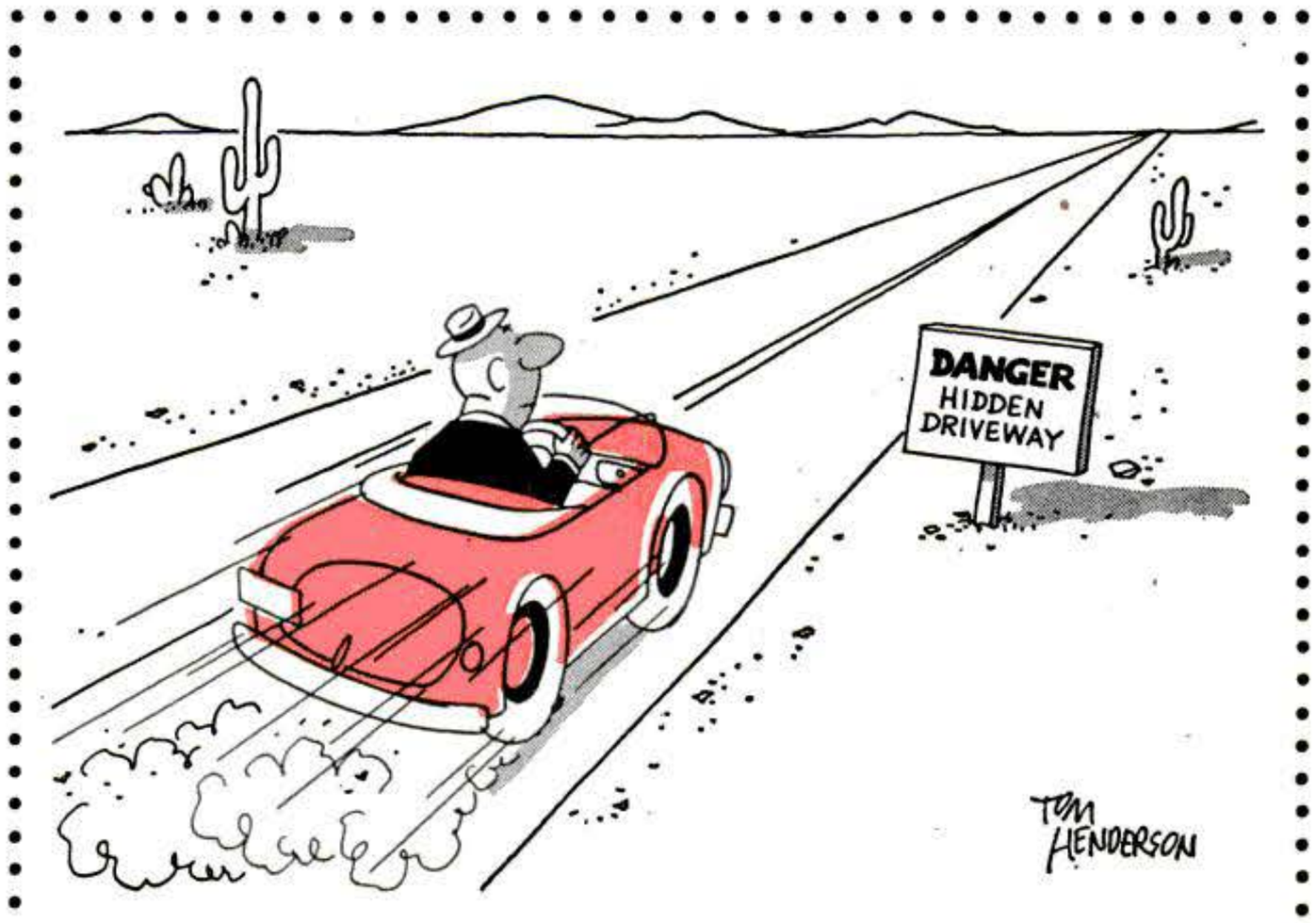
GUS picked up the broken universal joint. "It cost him a Christmas present for Lydia. Ten dollars, to be exact—which was all he had."

"I see," Andrews said. "What were you saying he did to the car?"

"This universal joint split open at the splines, but only because there was an old crack in it that had been there so long it had rusted. It might have gone at any time, John—yesterday, for instance, when your wife was out buying that Christmas turkey."

Andrews bent over to examine the broken part. "You're sure of this, Gus?"

"I'm positive, John," Gus said.



"In that case," Andrews said slowly, "I made the boy pay for something that wasn't his fault at all."

"Looks that way to me."

John Andrews stood silent a moment. "I'll slip the 10 dollars in his wallet after he's asleep tonight. Tomorrow I'll explain about the universal joint."

"That will *almost* do it, John," Gus said. Then, seeing the new question on Andrews' face, he continued: "The storm is about over. Maybe you could ride in the back seat on the way home. When a boy takes a girl out for a drive, he wants her to feel that he's competent to drive her home again."

Andrews looked intently at Gus. "Say, how come a bachelor like yourself knows so much about kids?"

"I'm an impartial observer," Gus said, smiling slowly. "If I had a son, I'd probably be tougher on him than you are."

"Maybe so," Andrews said. "But I'll take your advice this time, anyway. And, Gus . . . a Merry Christmas to you." END

NEXT MONTH: Gus smells trouble.

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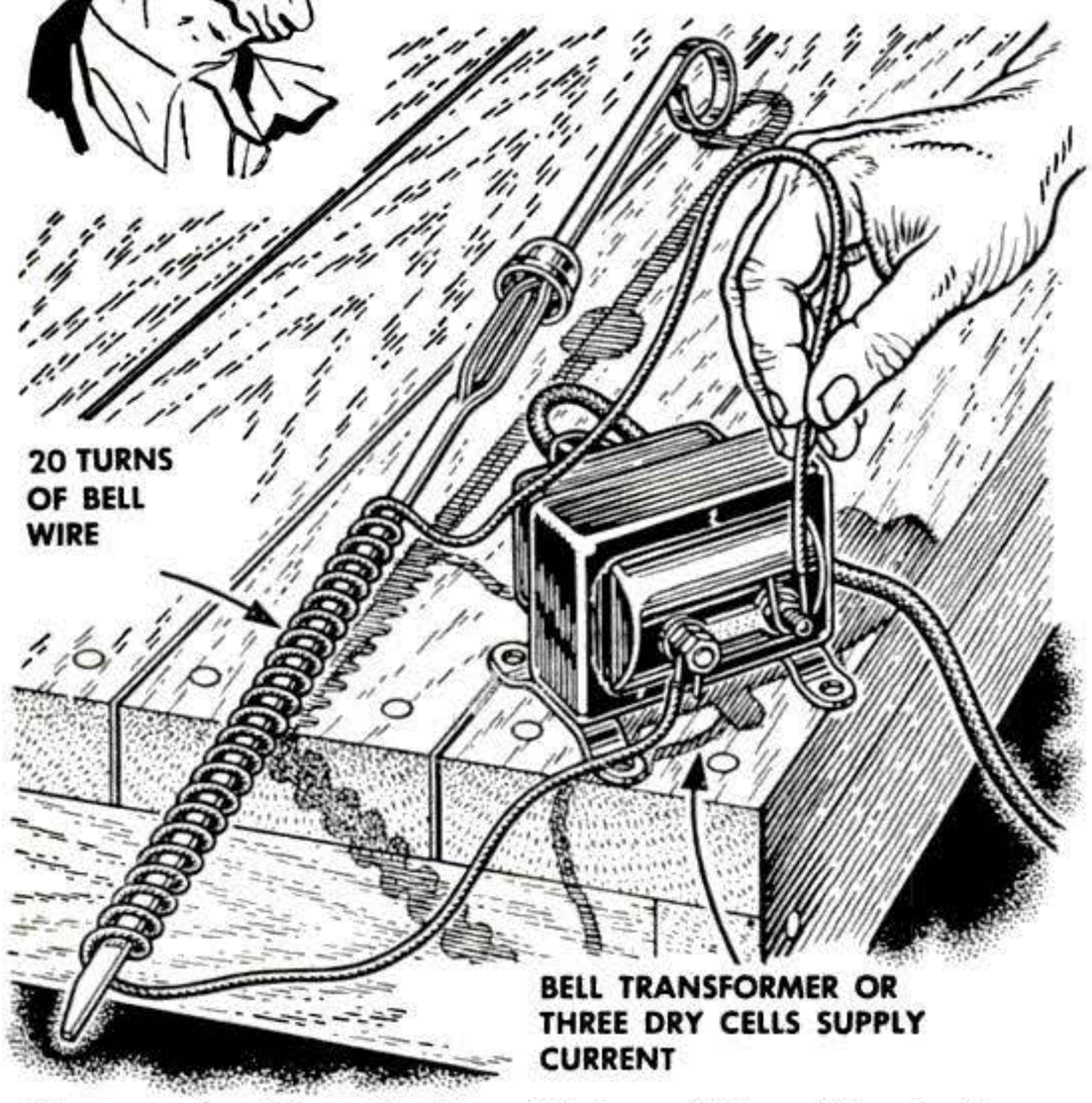
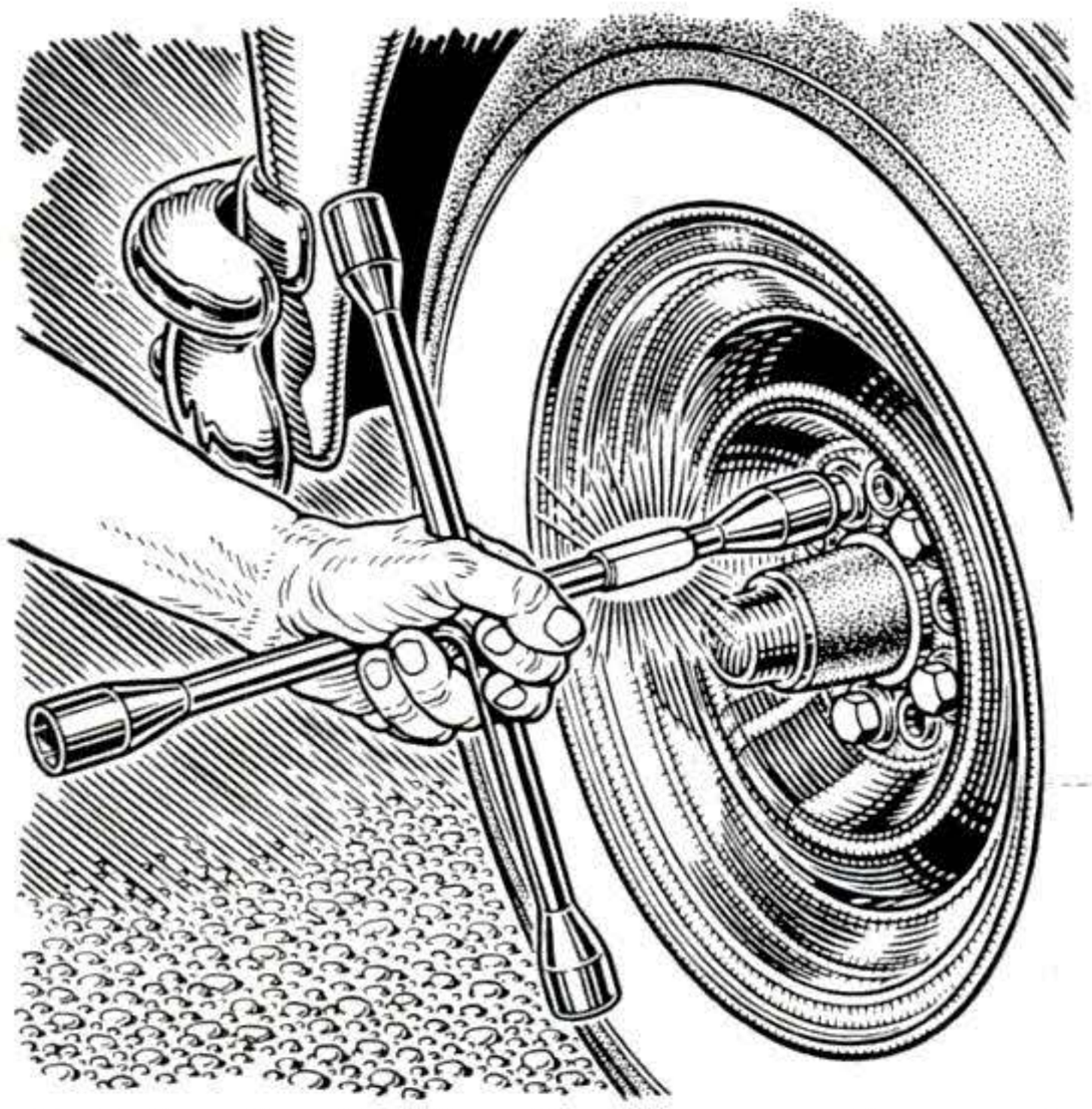
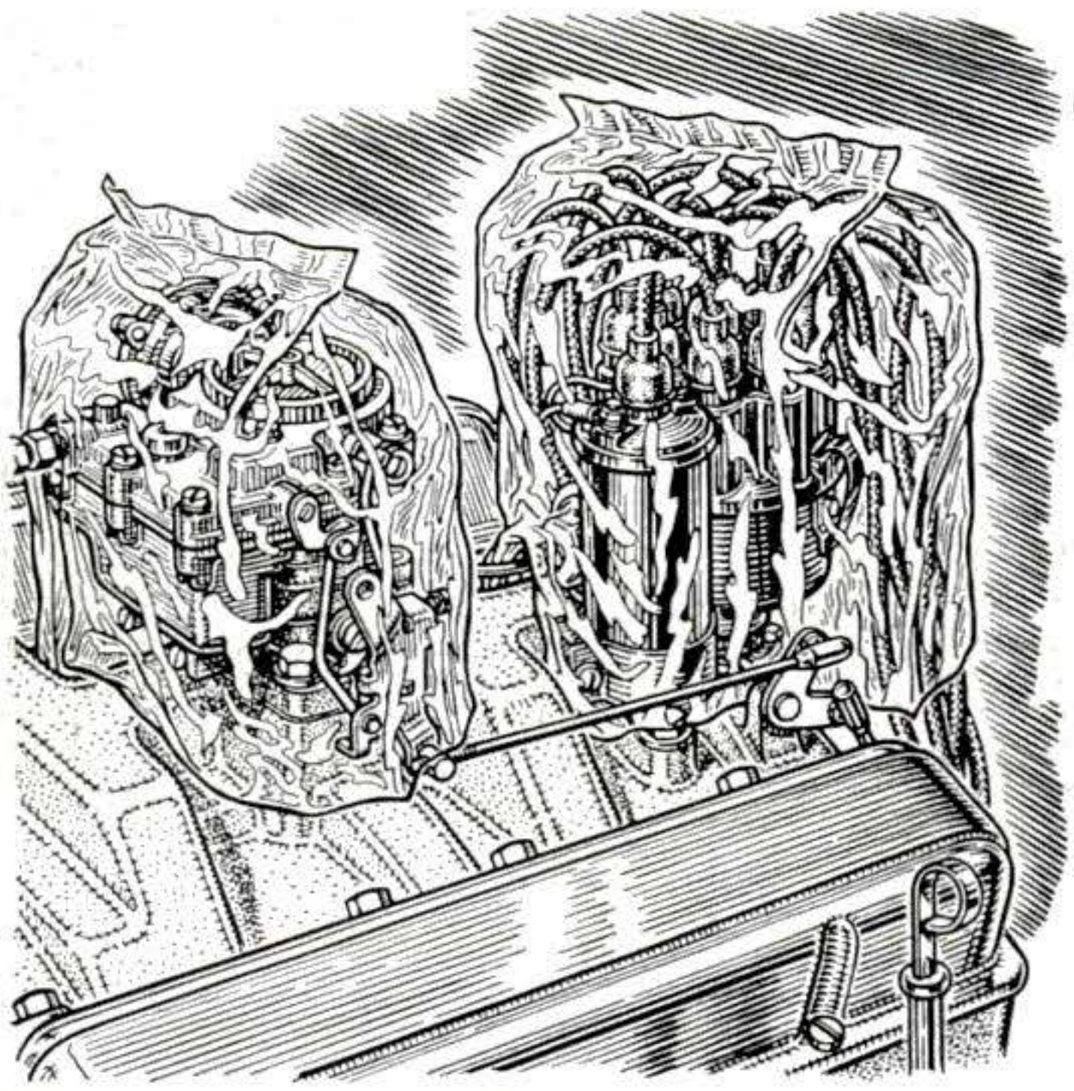
Hints from the Model Garage



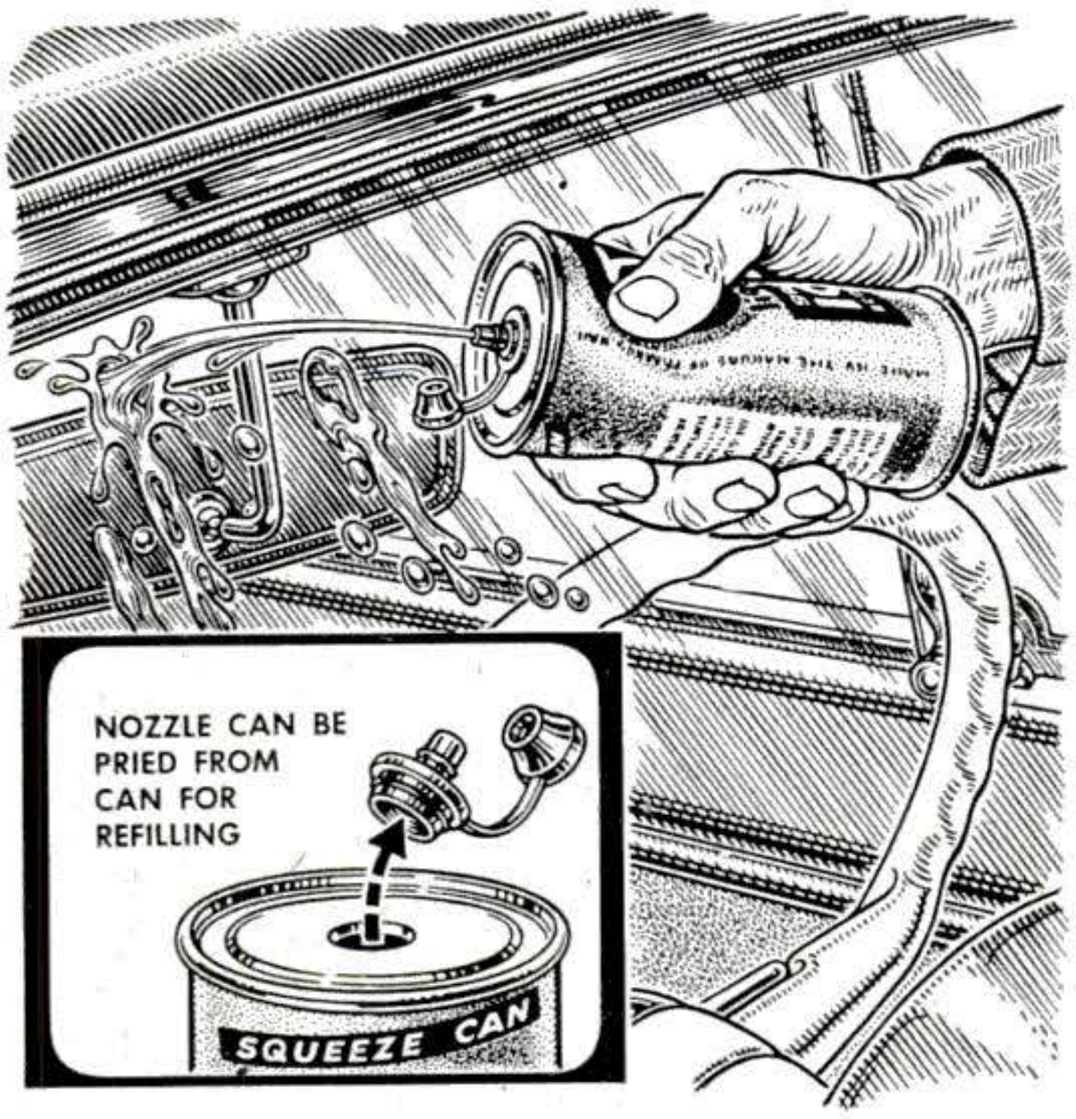
A magnetized dipstick will collect tiny iron and steel particles in a crankcase. Magnetize it with a quick pulse of current through a temporary coil. With AC you may need to repeat until you catch the current cycle at or near a peak.



A strip of reflective tape wrapped around one shank of a four-way lug wrench saves fumbling for the right socket when changing a tire. Little disks of the tape stuck on the bolt heads may keep them from being lost if you get a flat at night.



When washing or degreasing an engine, cover the carburetor, coil and distributor with plastic food-saver bags to keep them dry. After the washing, remove the covers and the engine should start easily, or at most after drying only the spark plugs.



To clear your windshield quickly of slush and muddy road spray raised by the cars ahead of you, squirt some water on the glass while operating the wipers. Store the water in one of the new squeeze cans used for liquid detergent.

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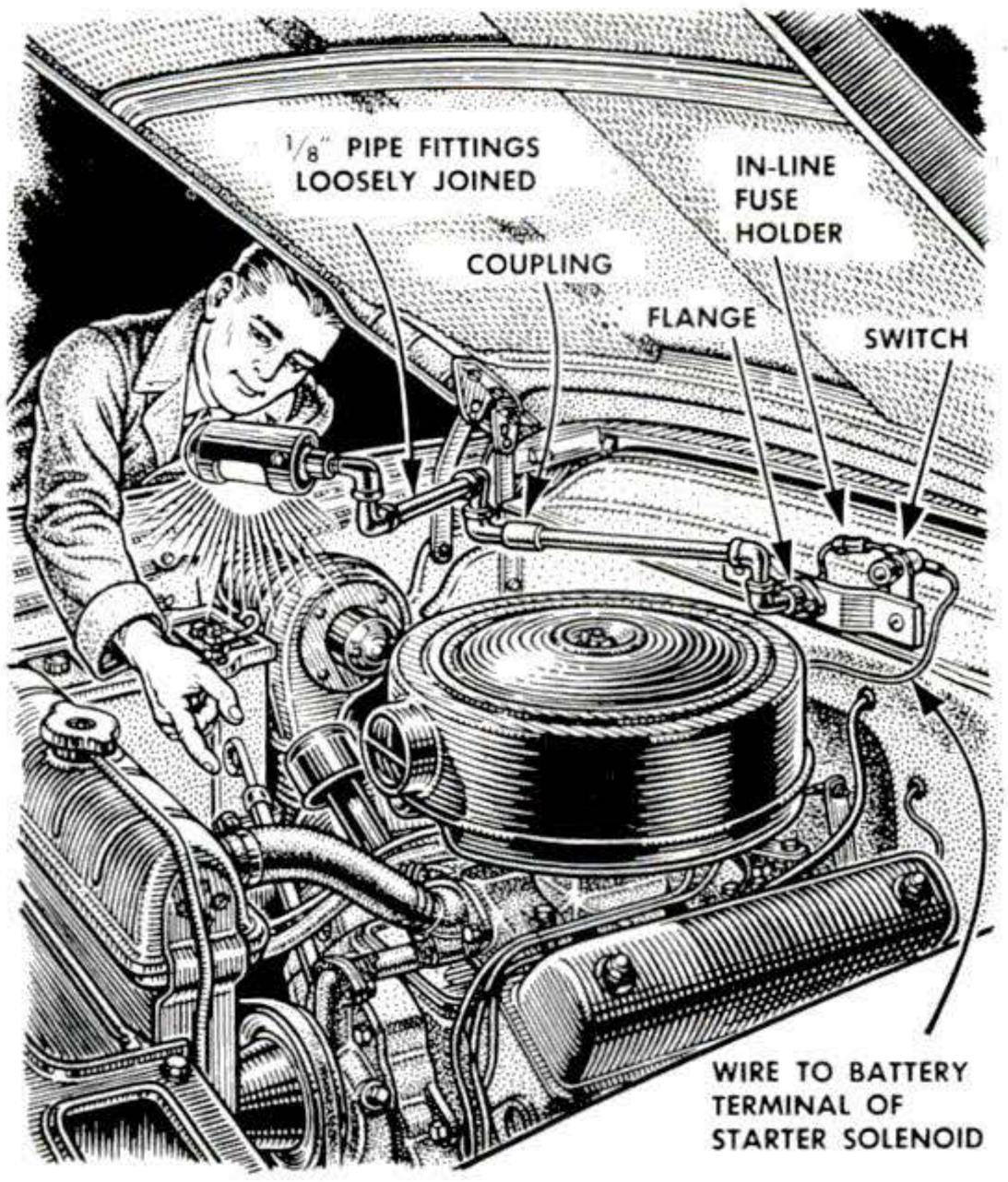
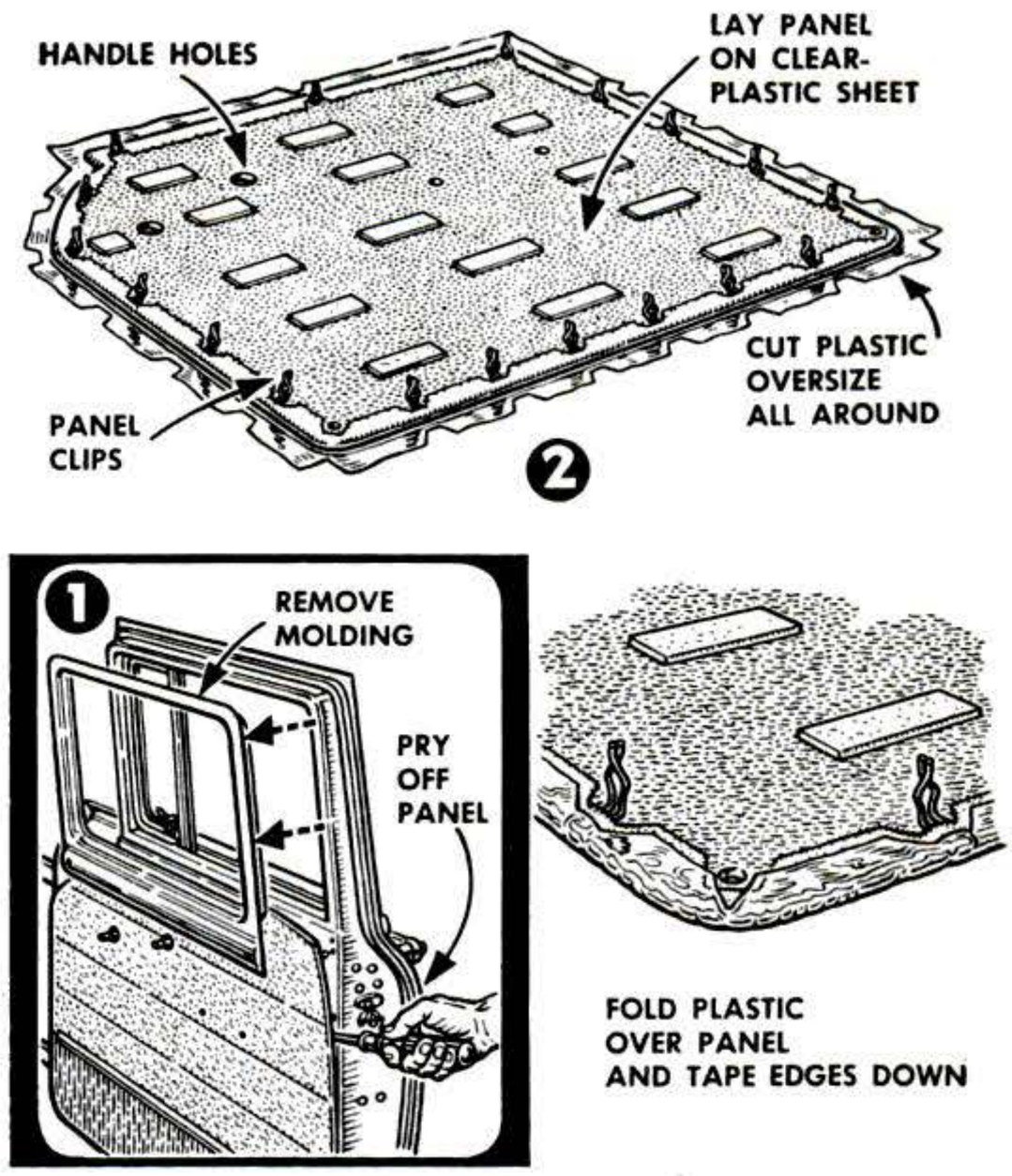
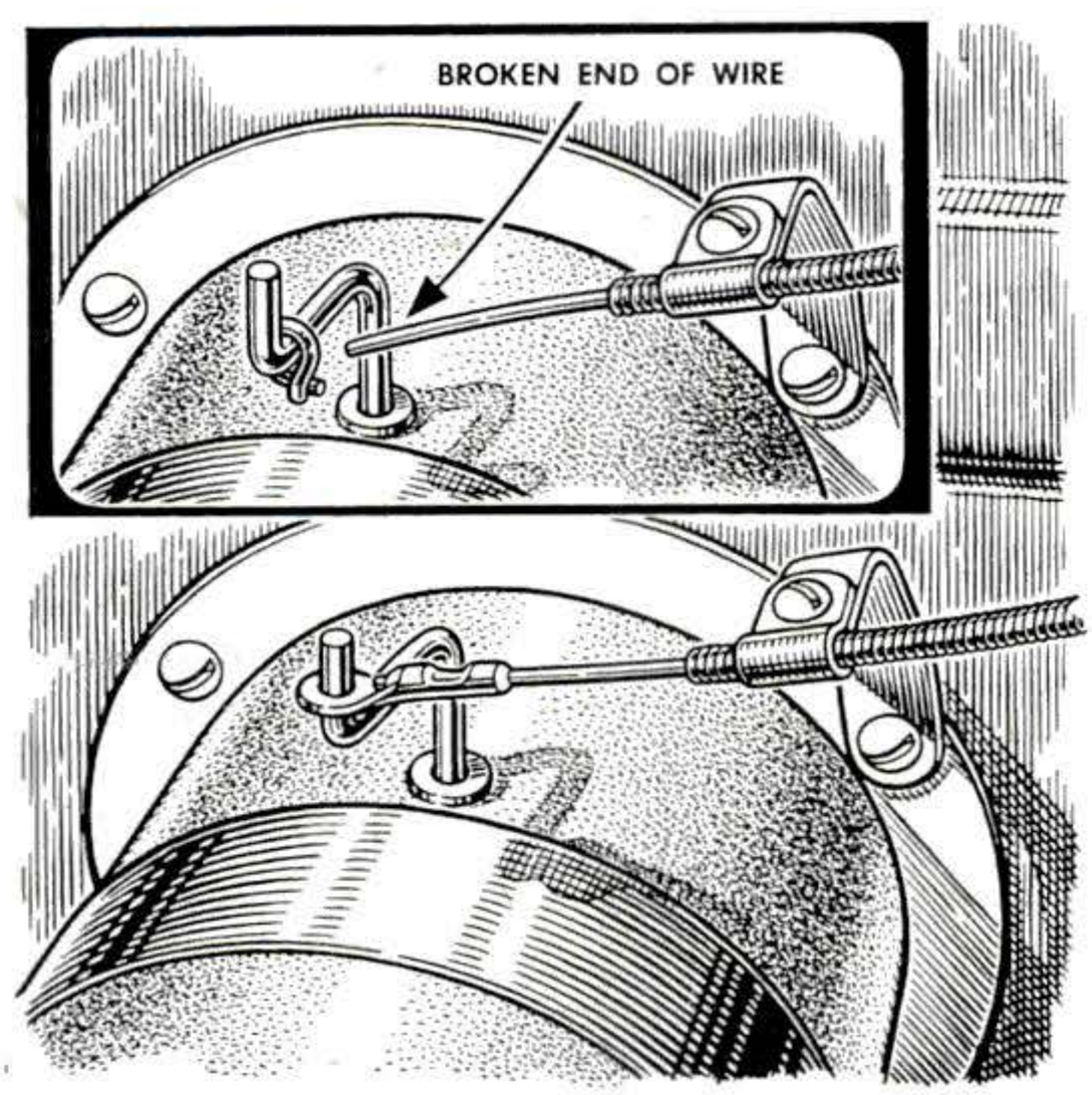


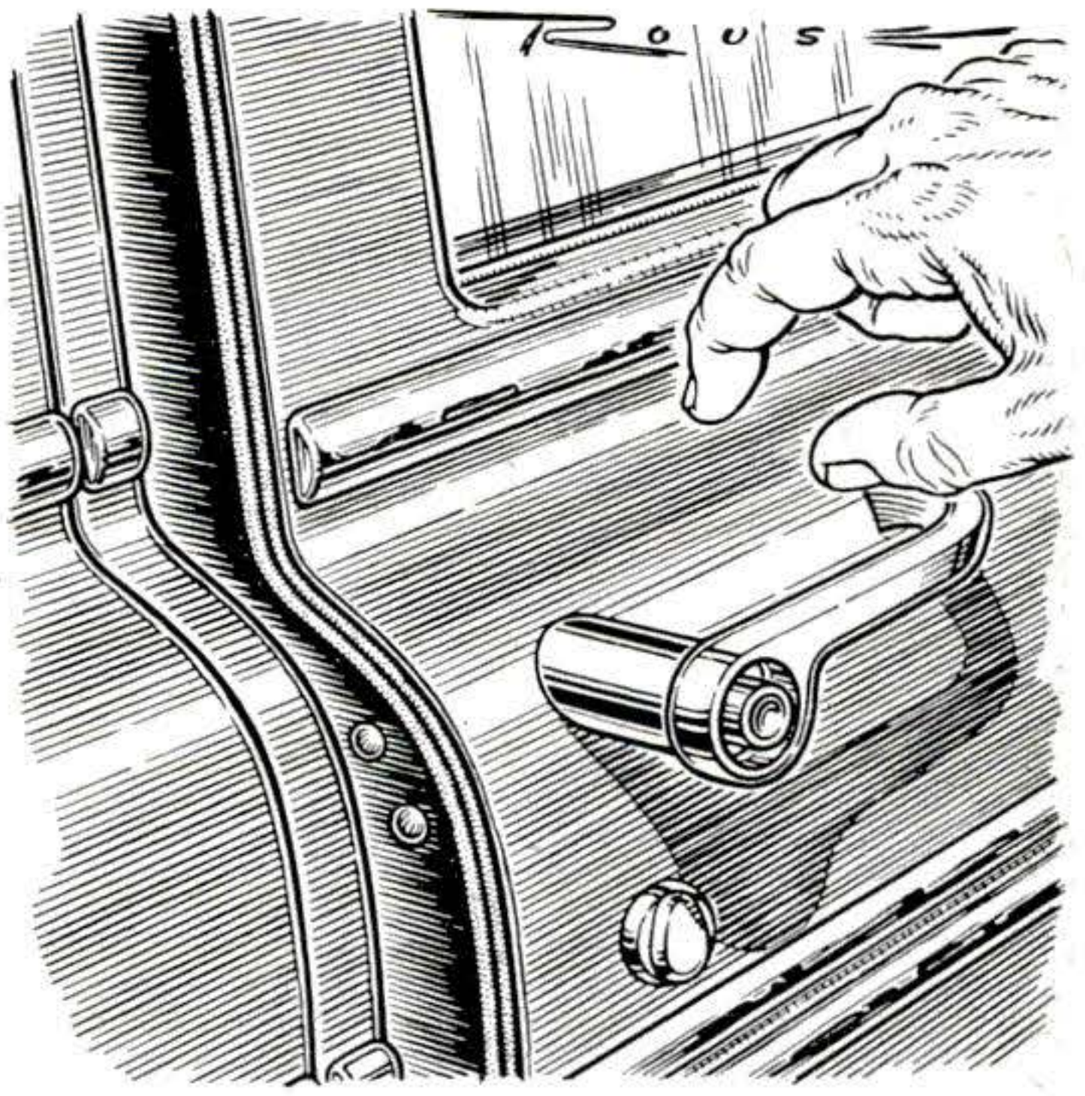
An under-hood lamp on swiveling pipe fittings puts light where you need it. Connect several feet of wire to a license-plate or map light and thread it through the fittings before loosely screwing them together. Bolt the unit to the fire wall.



Keep the new look in your car's interior by covering the cowl and door panels with sheets of clear plastic. Pry off the panels and cut the plastic to fit with an inch overlapping all around. Fold the edges over and secure them with tape.



A terminal lug makes a neat repair where the eye of a flexible control cable has broken off. Select a lug with a hole the diameter of the eye it will replace. Tin the end of the control wire or cable, slip on the lug and solder it in place.



Opening the doors slightly when you put your car in the garage after being out in the rain can add years to the life of the car's body. This hastens drying at critical areas such as door bottoms, which are usually the first to rust.

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Short Cuts and Tips

FROM PS READERS

Train Layout Rolls Under Bed

No SPACE for a train layout? A perforated hardboard panel, 47″ by 72″, makes this roll-away roadbed. Mount it on a framework of one-by-fours, put together with corrugated fasteners. A center brace keeps the panel level.

The wiring is hidden on the underside of the board and lead wires are brought up through the holes. The entire assembly rolls under the bed on four casters. If there is much equipment in your train layout, add a fifth caster at the center.

ROLLING STOCK DISAPPEARS under youngster's bed when not in use. It is mounted on pegboard, nailed or screwed to a frame. Wiring for transformer, tracks and outlets passes through holes.

Hinge Pin Sets a Nail

To SINK a common nail flush or a little below the surface without marring the wood, use the pin from an old door hinge as a nail set. The pins are well tempered and the ball top makes a handy striking surface.—*J. L. McClay, Pasadena, Calif.*

Basket Keeps Hose Off Floor

HUNT up an ordinary bushel basket and you've got a fine container for storing the garden hose over the winter. As much as 100 to 150 feet of hose, depending on its diameter, can be coiled in the basket. —*M. C. Anderson, Arlington, Va.*

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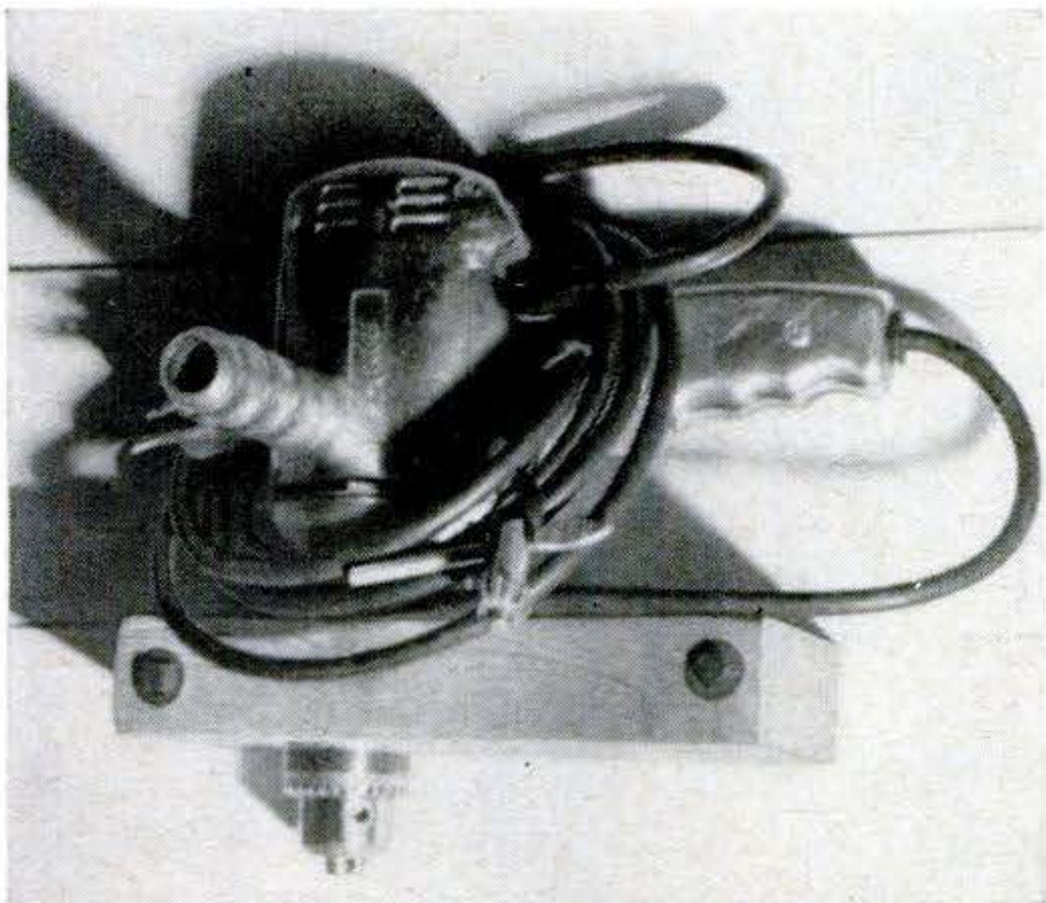
LAYOUT COMPONENTS are easily attached by means of perforations. Tracks will be secured with wire from underside of panel. Toy animals (see inset), trees and other landscape decorations have 3/16" pegs glued into drilled holes. Pegged down, they'll remain upright under vibration.



Block Racks Up Electric Drill

BORE a hole through a 2"-by-4" block to take the chuck of your electric drill and you have an excellent storage rack. Bolt the block to a wall or cabinet. The drill can't slip out, yet is easily removed for use.—*E. V. Reyner, Townsend, Mont.*

Do You Have a Short Cut? Send It in and Win a Prize

HAVE you discovered or developed a money-saving tip or a time-saving short cut in home upkeep or repair? In shop techniques? In hobby activities? Or do you know someone who has?

POPULAR SCIENCE will pay a cash prize for every item accepted, the amount ranging from $8 for a description alone, to $12 or more for items with at least one sketch or publishable photo. Rough pencil sketches are acceptable, just so they illustrate the idea clearly. Include negatives with small-size photos. Address your entry to Short Cuts Editor, POPULAR SCIENCE, 353 Fourth Ave., New York 10, N.Y.

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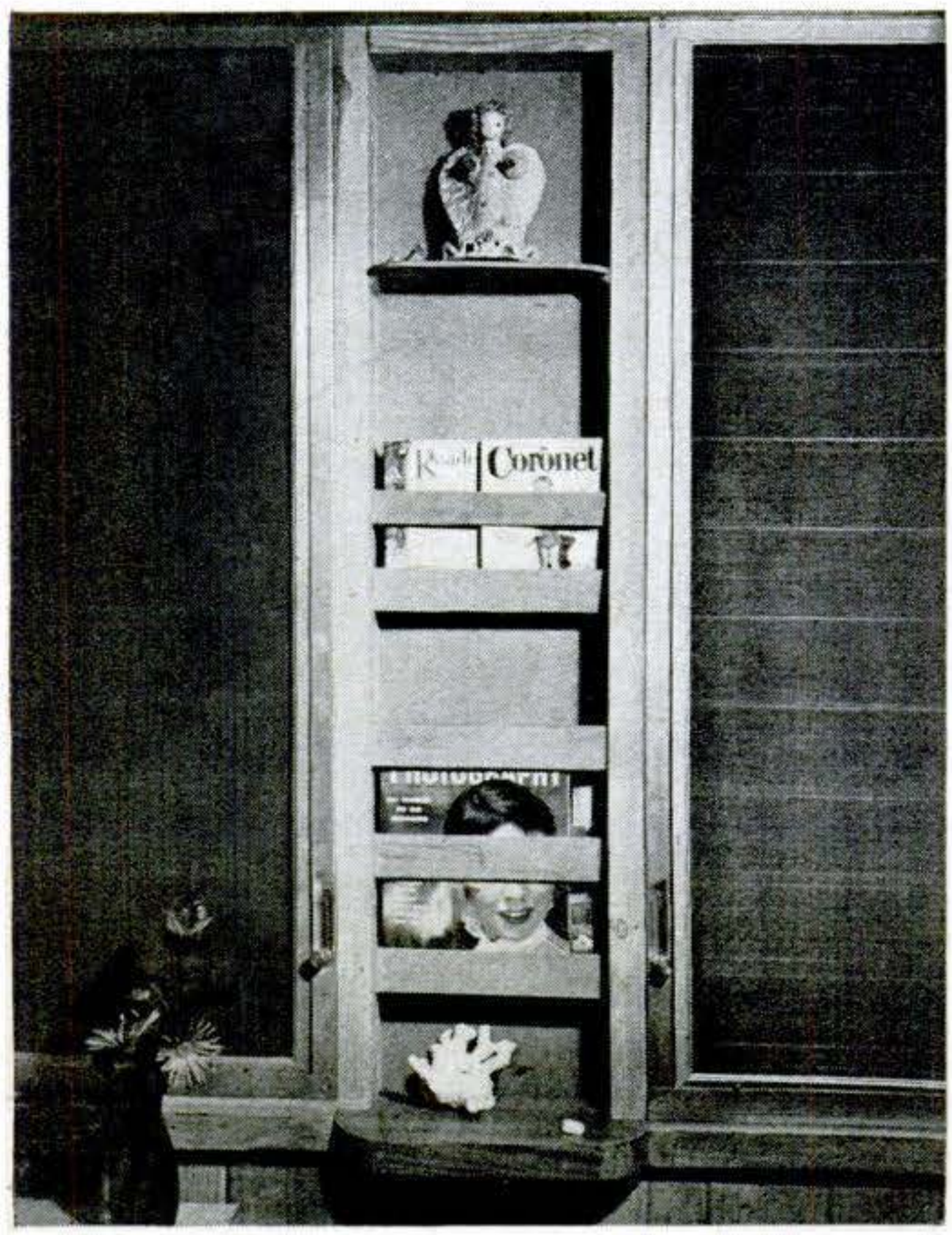
Short Cuts and Tips

Overhead Rack Holds Lumber

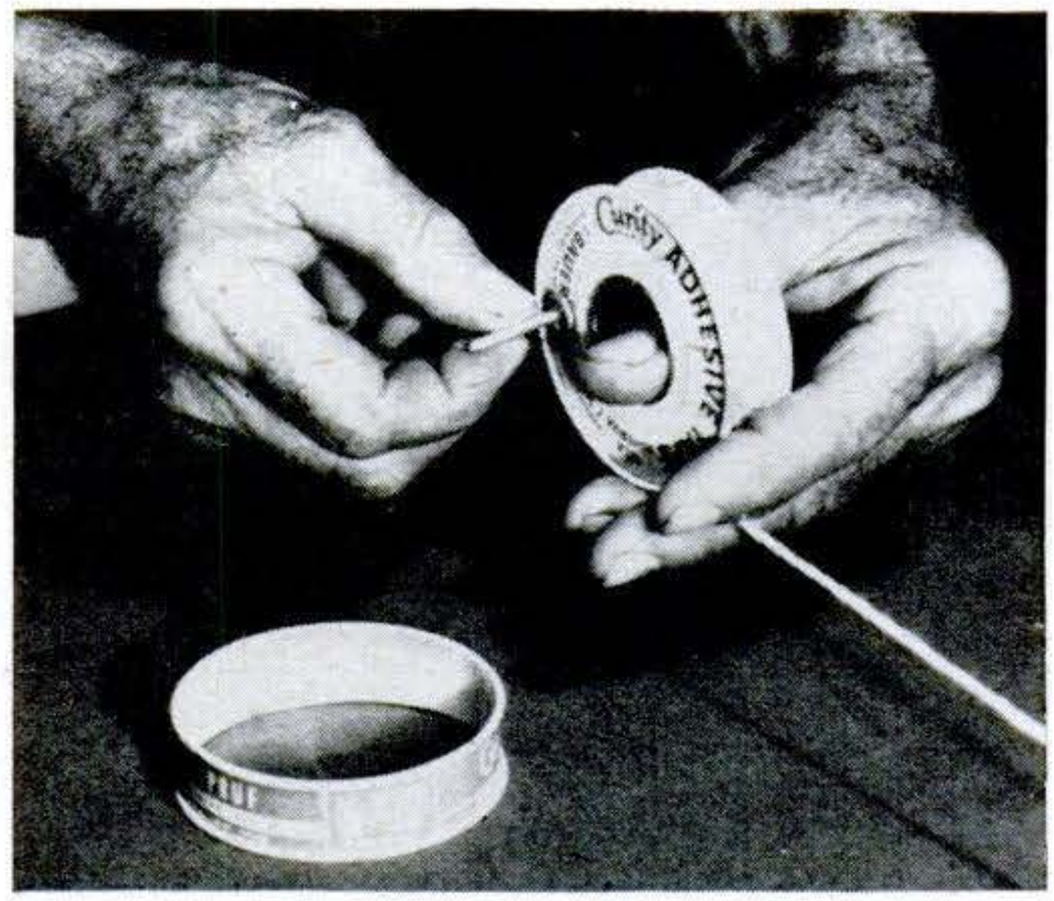
To STORE extra lumber neatly, I utilize the space between the overhead joists in my basement. Several crosspieces secured to the joists support the wood and allow me to slide in boards of different lengths. The lumber is not only out of the way, but selection of stock is easy, too.—*Jack Stockwell, Philadelphia.*



Wall Studs Frame Rack

WHILE enclosing an open porch, one homeowner swiped some of the normally hidden space between studs and gained a built-in magazine rack and what-not.

He used the studding as a framework and put in a hardboard backing. The niche holds three shelves, two with front strips to rail in magazines. A plank closing the base of the opening makes a shelf wide enough for a telephone.



Tape Spool Holds Chalk Line

NEED a reel for a chalk line? File off the point of a roofing nail and solder its head to an adhesive-tape spool. To reel in 50′ of line in a jiffy, just poke a thumb through the spool hole and turn the crank.—*Harold Jackson, Kankakee, Ill.*

▶▶▶THE factory advises removing the engine to replace the oil pump on a Pontiac 8 (1949-1954 models). But I have worked out a way to eliminate this step.

After removing the battery and battery seat, I unbolt the exhaust pipe, front motor support and radiator hoses. Then I jack up the engine 6″ and, with a smaller jack held horizontal, push the engine 7″ to the left. The entire job takes only an hour.—*Frank Cingolani, Altadena, Calif.*

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Go ahead and build a 26 foot rocking horse if that's what Junior wants for Christmas! But whatever your needs—family Christmas gifts or year round home improvement projects—you can build them with SHOPSMITH from *start* to *finish*. Only SHOPSMITH is a complete power shop in one magnificently engineered unit. No extra tools to buy. And, unlike one-speed power tools, only SHOPSMITH gives you Speed-Dial selection of correct, safe tool speeds (700 rpm to 5200 rpm!) assuring professional results with every woodworking operation. Visit your leading hardware or department store, lumber yard, or any Montgomery Ward, and find out why over 250,000 men now own SHOPSMITH. For two helpful free books on home workshops, write Magna Power Tool Corp., Dept. 303-S, Menlo Park, Calif., or Dept. 303-S, Box 2808, Fort Wayne, Ind. ®T.M. REG.

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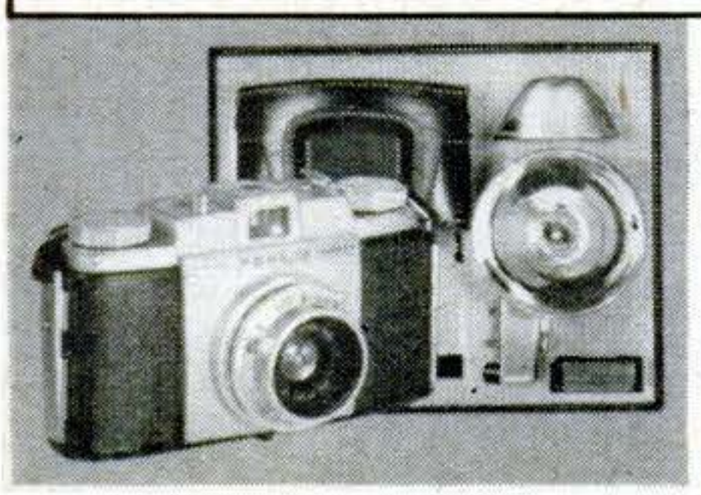
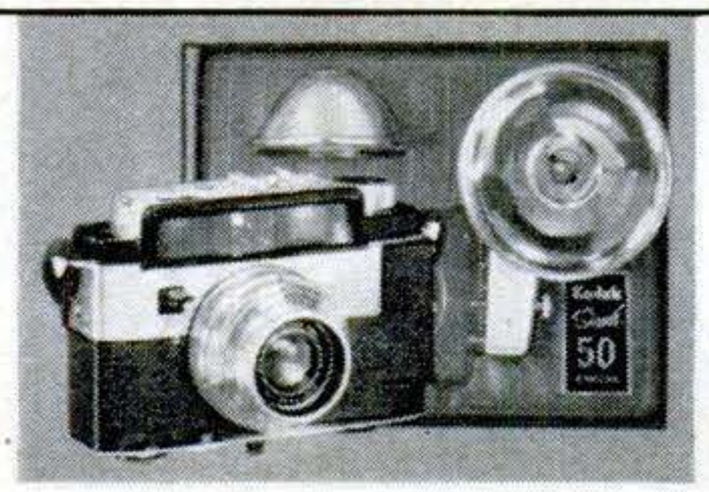
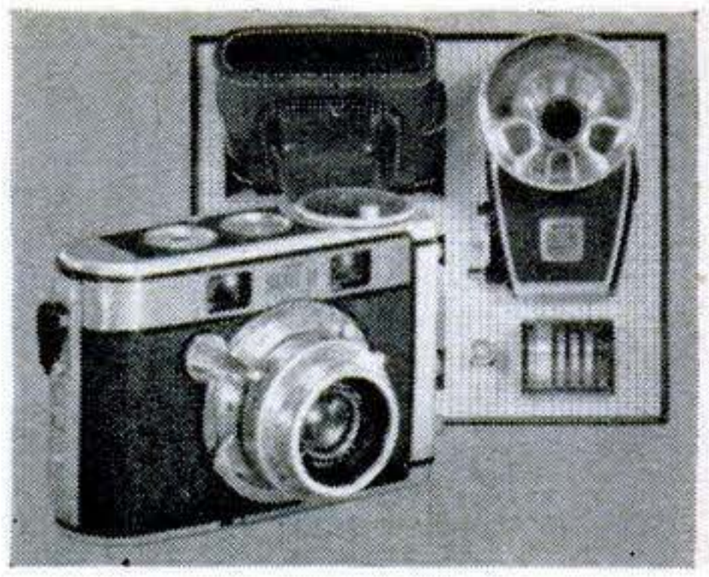
TO TAKE AND SHOW COLOR SLIDES BIG AS LIFE . . .



New Kodak Pony IV Camera features simplified exposure settings, zone focusing. Complete with camera, flasholder, case, slide viewer. Kodak Pony IV Camera Outfit, $58.40 (Camera alone, $39.95)



Built-in meter tells exactly how to set camera for just-right exposures! Kodak Signet 50 Camera with two-reflector flasholder, $82.50 (Kodak Signet 30 Camera, same basic camera without meter, $55)

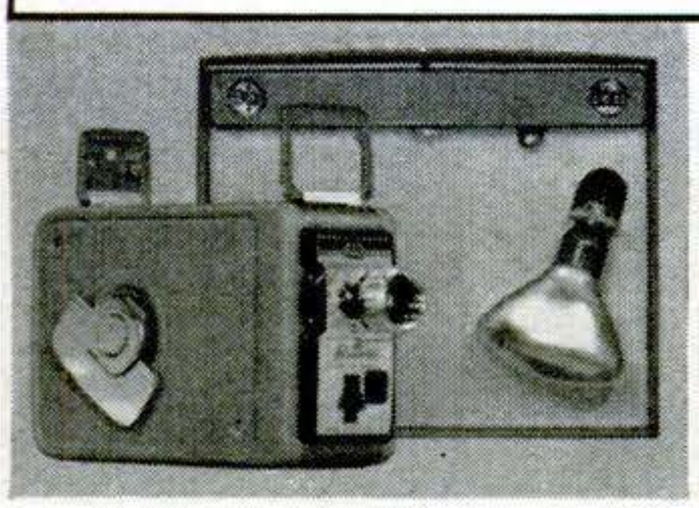


Kodak Signet 40 Camera in luxury gift outfit includes case, Kodak Rotary Flasholder, battery, Kodak Filter Kit. Kodak Signet 40 De-Luxe Outfit, $96 (Camera and Super-M 40 Flasholder, $74)

Christmas Gifts from Kodak

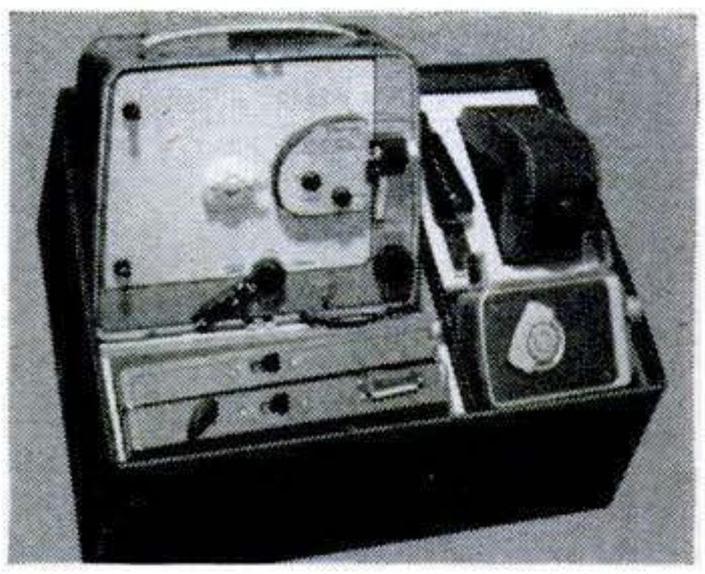
When you open a Kodak Camera Outfit first, you can save all the fun of Christmas—and years to come—in pictures

8mm MOVIES—FINEST FAMILY GIFT OF ALL . . .

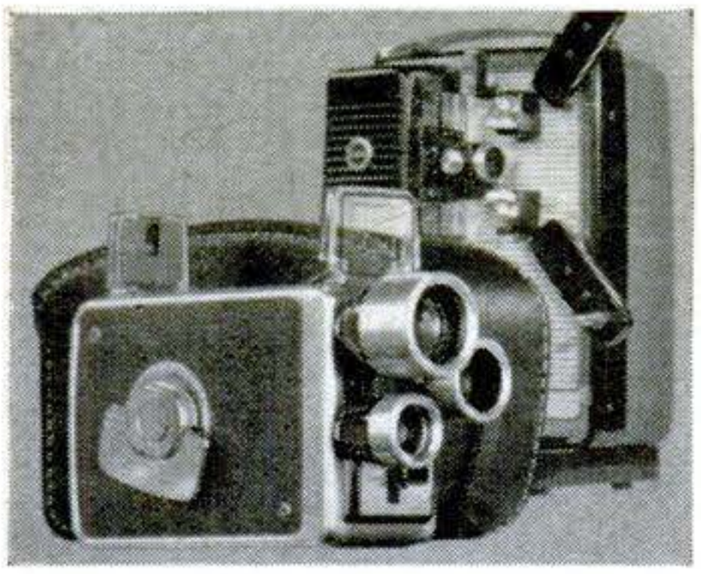


Brownie Movie Camera *f*/2.7 takes color movies with snapshot ease. Complete with Brownie 2-Lamp Movie Light and flood lamps for indoor use. Brownie Movie Camera Kit, *f*/2.7, $38.40 (Camera, $29.95)

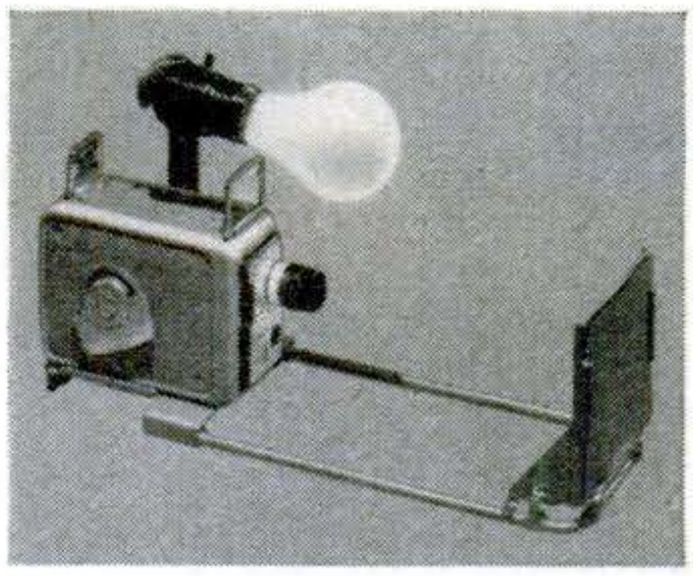
Complete movie outfit—Brownie Movie Camera, *f*/2.3; Brownie 300 Movie Projector shows movies 3 feet wide. Brownie 300 Movie Outfit complete, $104.70 (Camera, $39.75. Projector, $64.95)



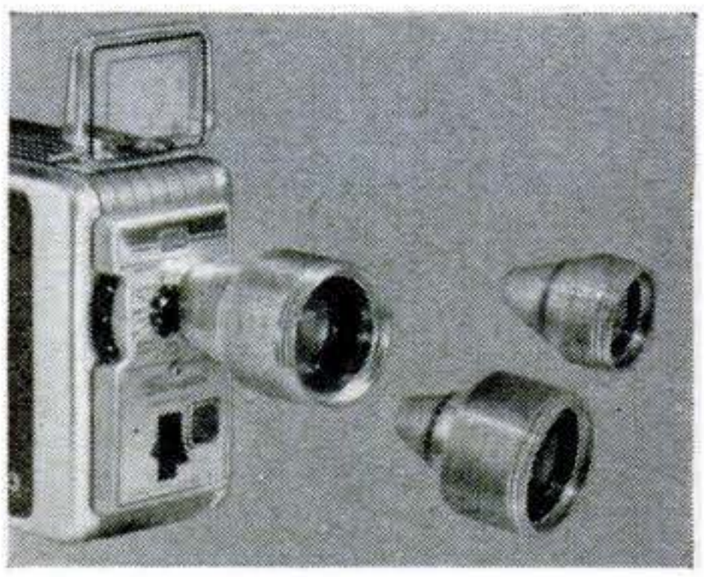
Take and show movies up to *4 feet wide!* Brownie Movie Camera *f*/1.9, case, 4-lamp light bar, Brownie 500 Movie Projector. Brownie 500 Movie Outfit complete, $144.95 (Camera alone, $49.75)



Brownie Movie Camera, Turret *f*/1.9 takes normal, wide-angle, telephoto movies; Cine-Kodak Showtime 8 Projector shows 8mm movies extra bright. Kodak Super 8 Movie Outfit, $214 (Camera, $84.75)



Titles and close-ups are easy with this titler for Brownie Movie Cameras. Includes camera platform, close-up lens, light bar, easel, title cards, "special effect" masks. Brownie Movie Titler Outfit, $15.95



Take panoramic wide-angle or close-up telephoto views with your single-lens Brownie Movie Camera. Converters slip over regular lens. Kodak Wide-Angle and Telephoto Converters, $18.50 each.

EASTMAN KODAK COMPANY, Rochester 4, N.Y.

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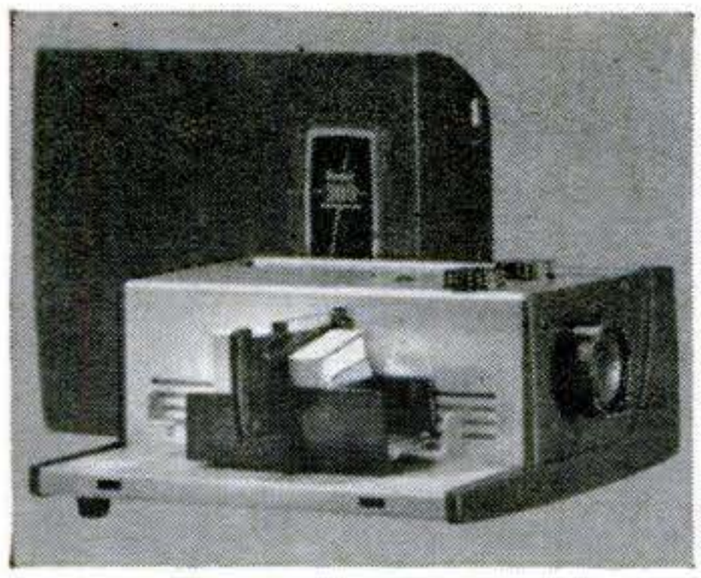
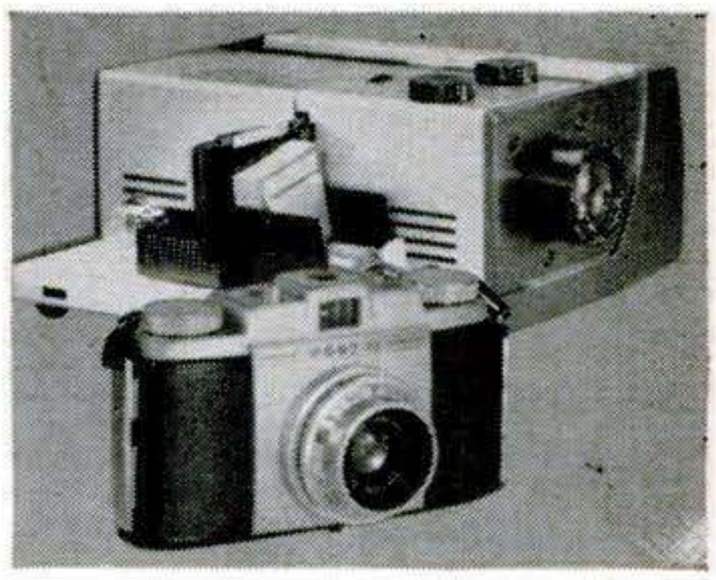
Kodak Retina Camera outfits include telephoto and wide-angle lens components, case, carry-all bag. Kodak Retina IIIC Camera Outfit, $394 (Camera, $175). Kodak Retina IIC Outfit, $351 (Camera, $132)



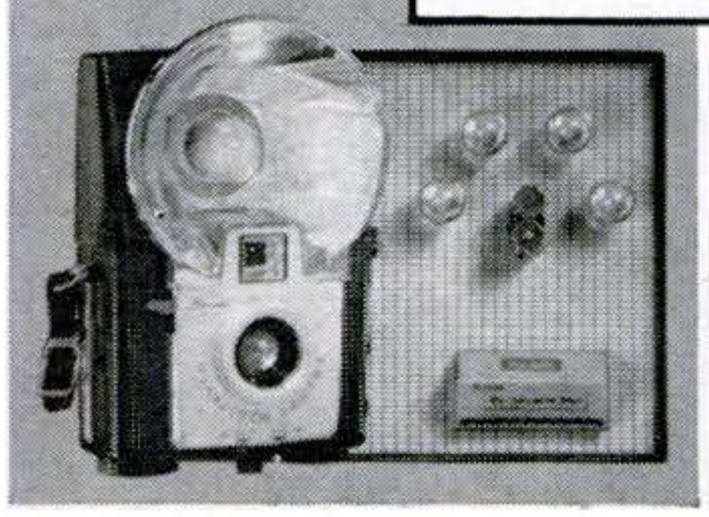
Kodak 300 Projector is ultra-portable, shows color slides big and bright. Quiet; cool; has finger-tip controls. Kodak 300 Projector with Readymatic Changer, $64.50 (with Magazine Changer, $74.50)



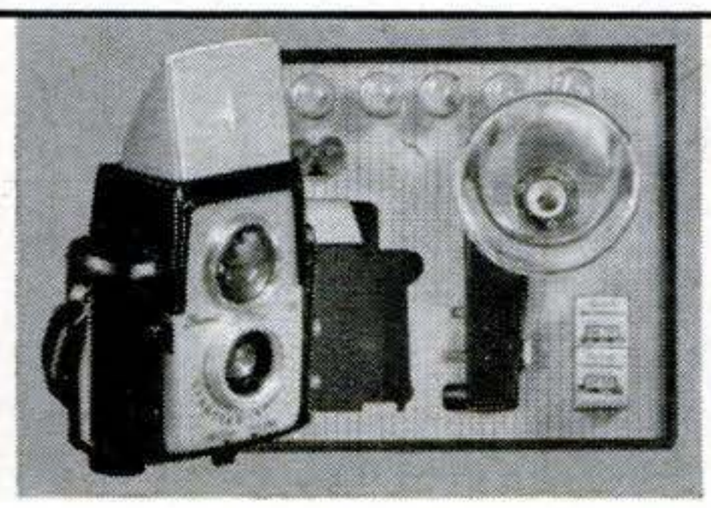
Complete color-slide outfit. Includes Kodak Pony IV Camera, Kodak 300 Projector. Kodak Pony Color-Slide Outfit, $104.50 (Kodak Signet 40 Color-Slide Outfit with same projector, $138.50)

say *Open me first!*

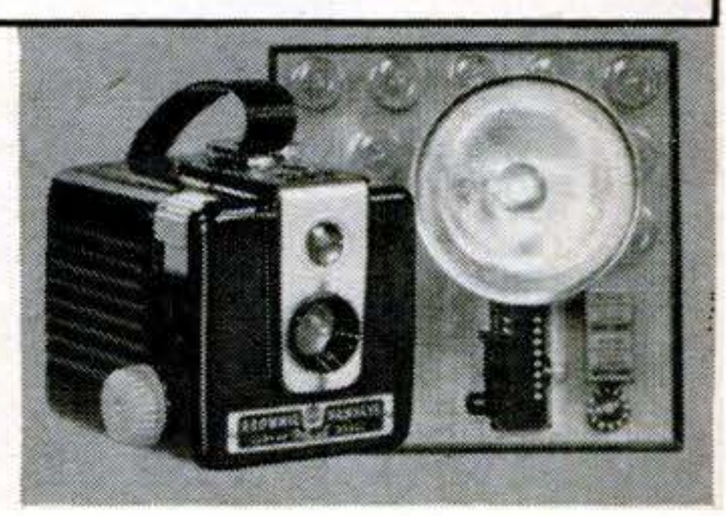
FOR 'ROUND-THE-CLOCK SNAPS IN BLACK-AND-WHITE OR COLOR . . .



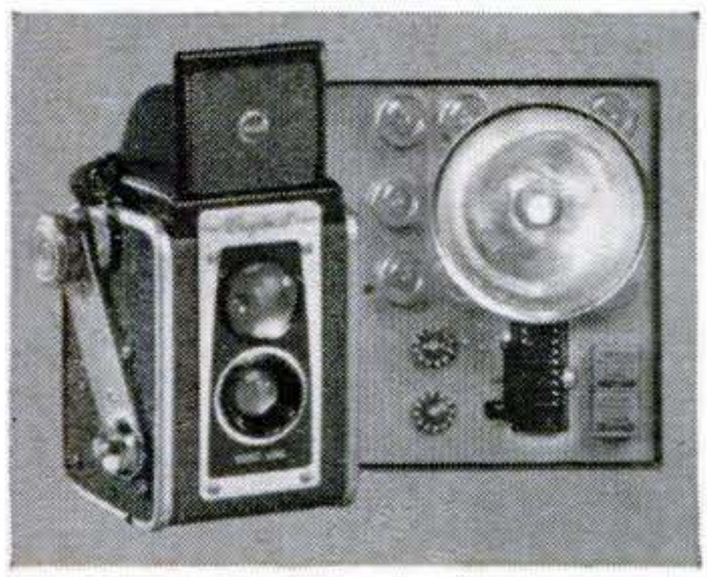
Brownie Starflash Camera takes color slides, black-and-white and color snaps. Built-in flasholder. Complete with bulbs, batteries, film. Brownie Starflash Outfit, $9.95 (Camera alone, $8.95)



Brownie Starflex Camera "previews" your shot, takes color slides and snapshots. Complete with camera, flasholder, batteries, film. Brownie Starflex Outfit, $16.50 (Camera alone, $10.75)

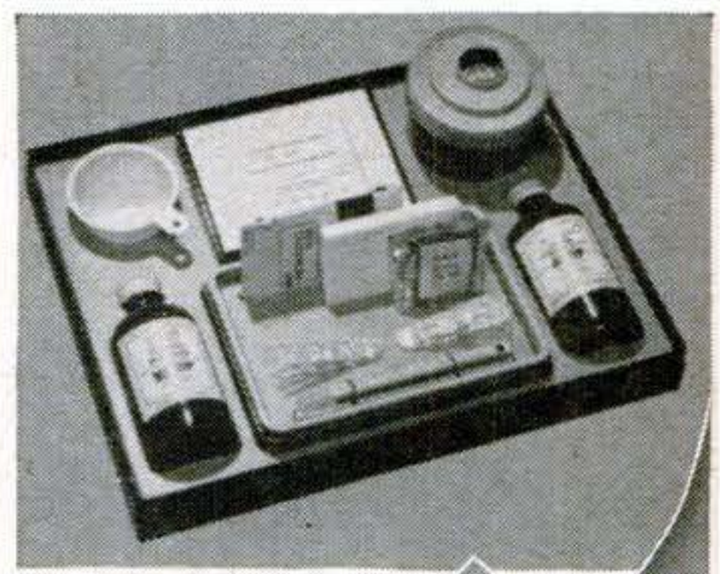


World's most popular snapshot camera in a gift outfit complete with Brownie Hawkeye Camera, flasholder, batteries, bulbs, film. Brownie Hawkeye Flash Outfit, $15.25 (Camera alone, $7.95)



Preview-finder of Kodak Duaflex IV Camera shows picture *big!* Complete with camera, flasholder, batteries, bulbs, film. Kodak Duaflex IV Flash Outfit, $25.25 (De-Luxe Flash Outfit, $38.75)

New Kodak Rotary Flasholder permits you to shoot six flashbulbs without reloading. Two models to fit most cameras. Kodak Rotary Flasholders, from $10.95 (Batteries not included.)



Kodak Photo-Hobby Outfits for developing negatives, printing snapshots at home. From $10.75

Kodak
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Prices are list, include Federal Tax wherever applicable, and are subject to change without notice

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Short Cuts and Tips

Magnifier Is Worn in Eyeglasses

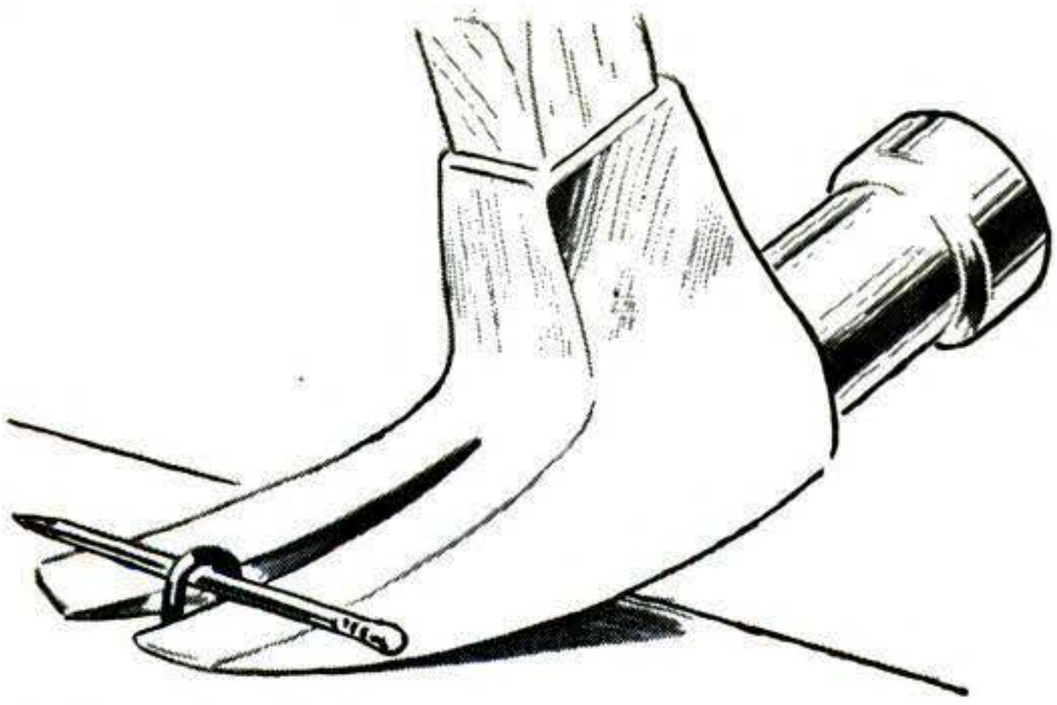
HOBBYISTS often want to use a jeweler's magnifying glass, but they quickly find that it takes a real knack to hold it in position at the eye. One easy way is to knock out a lens in a discarded pair of eyeglasses, and insert the loupe. If it's a loose fit, tape it to the frame with electrican's tape. —*R. C. Philipp, Gordon, New South Wales, N. Z.*

Utility Trays? Try Foil Pans

HAVE your wife save the little foil pans that hold pies, frozen macaroni and other foods. They are perfect for mixing glue, cleaning paintbrushes and countless other jobs in the shop. If you don't buy foods packed this way, the disposable pans can usually be purchased by the package, too. —*R. B. Stearns, Hialeah, Fla.*

Make Your Own Screw Anchors

YOU can make your own screw anchors for masonry from toothpaste tubes. Cut a strip of the tubing and roll it around a nail to make a plug that fits the star-drilled hole. When a wood screw is turned tight in the soft, pliable metal, you have a fastener that is adequate for most purposes.—*Michael Liggett, Muncie, Ind.*



Hold-Tight Staple Loses Its Grip

A STAPLE will pull out easily without bending if you tap a nail through it and then lift the nail with the claws of a hammer.—*M. Scott, Minneapolis.*

▶▶▶WHEN you hang plywood cabinet doors, prop them open for a week to 10 days so both sides dry at the same room temperature. This will reduce warping and twisting.—*Henry Josephs, Gardenville, Pa.*

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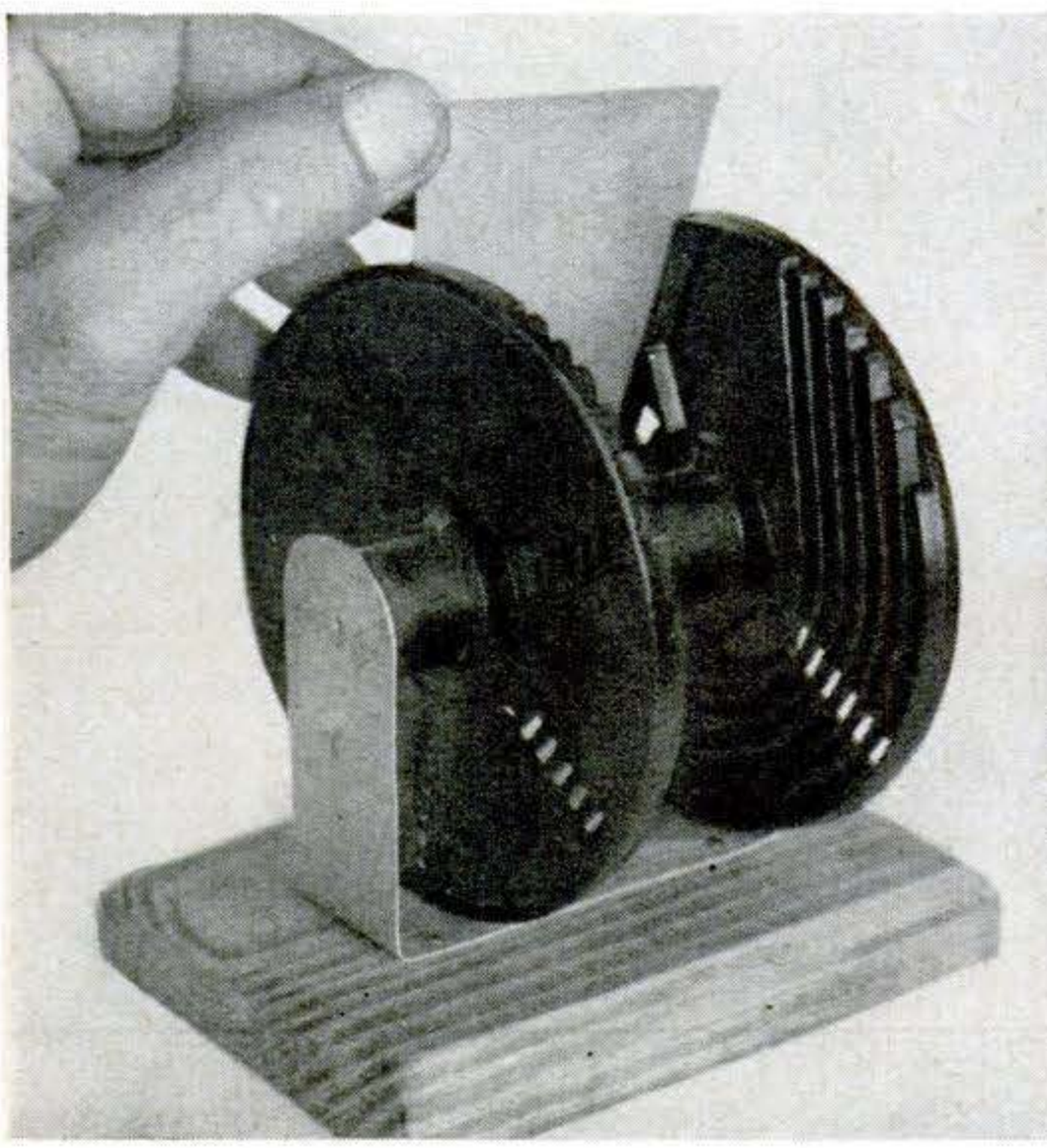
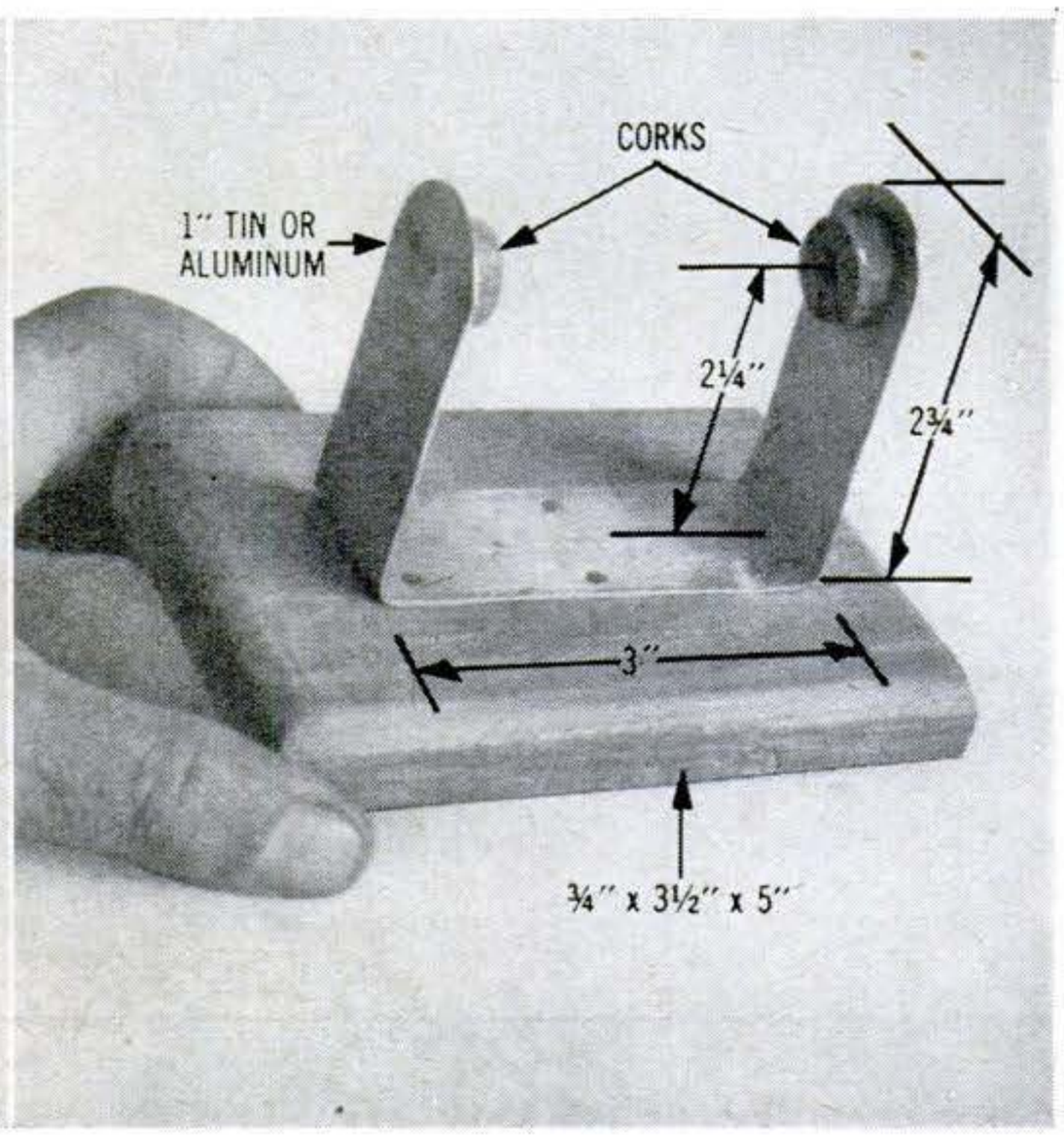
Short Cuts and Tips

Wire Mesh Lets Boots Dry Fast

To DRY fishing boots or waders easily and thoroughly, insert tubes of wire screening. The rolled screening keeps the boots open at the top and the mesh openings let air circulate to speed up drying. —*John Krill, North Lima, Ohio*

▶▶▶WHEN the screw holding a washer in a faucet works loose, it sometimes lodges deep inside the faucet. One simple way to remove it is to flush it to the surface. Just turn on the water at the main for a moment after removing the faucet stem. Put a cloth around the faucet opening to keep water from running over the sink edge.—*A. L. Levitt, Cambria Heights, N.Y.*





Cork Wedges Hold Reel to Speed Up Loading of Cut Film

I MADE myself a simple rack for holding a cut-film reel for faster and easier loading in the dark. It's just a strip of metal 1" wide bent into a U and tacked to a wooden base. Two corks of ⅝" diameter, tapered for a push fit in the center post of the reel, are cemented to the upright arms.

When the reel is slipped into the holder, it is gripped firmly by the corks and the slots are always face up so that you don't have to grope around to find them. —*A. P. Zanelli, Tampa, Fla.*

▶▶▶BEFORE using a ladder, give it a safety check by laying it on the ground and walking its full length, stepping on each rung. Any rungs that show weakness or turn in their sockets should be replaced at once.—*John A. Coombs, Philadelphia.*

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'58's real eye-opener is CHEVY!

And that's a fact. You never saw so much sharp engineering, so many advanced ideas, such stunning changes packed into one year's progress. You'll spend hours studying this one and never run out of surprises. For '58, Chevy's new from the paint on in—and that means body, suspension, chassis, engines . . . the works! Sure, they're lovely to look at. But come on down and get the real eye-opener, the inside story! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

- LEVEL AIR RIDE—100% air springs, front and rear.*
- 3 CARBURETORS on Super Turbo-Thrust V8 . . . and 280 h.p.!*
- NEW WHEELBASE—2½ inches longer for extra room and comfort.

*Optional at extra cost.
**Except with Overdrive.

- TURBO-THRUST V8 with combustion chambers in the block!*
- CLOSE-RATIO Synchro-Mesh transmissions on all V8's.**
- NEW BODIES—9 inches longer, up to 2½ inches lower.
- DUAL HEADLAMPS for better light pattern, longer low beam.
- NEW BODY-FRAME design has double-wall cowl for added rigidity.
- 4 COIL SPRINGS with advanced Four-Link rear suspension.
- NEW IMPALA luxury models rival the costliest cars.
- 348-CUBIC-INCH Turbo-Thrust V8's with "gable-roofed" pistons.
- NEW FRAME—has new X-design for extra lowness.
- FUEL INJECTION—top efficiency, instant acceleration.*

CHEVROLET

- TURBOGLIDE, the super-smooth, triple-turbine transmission.*

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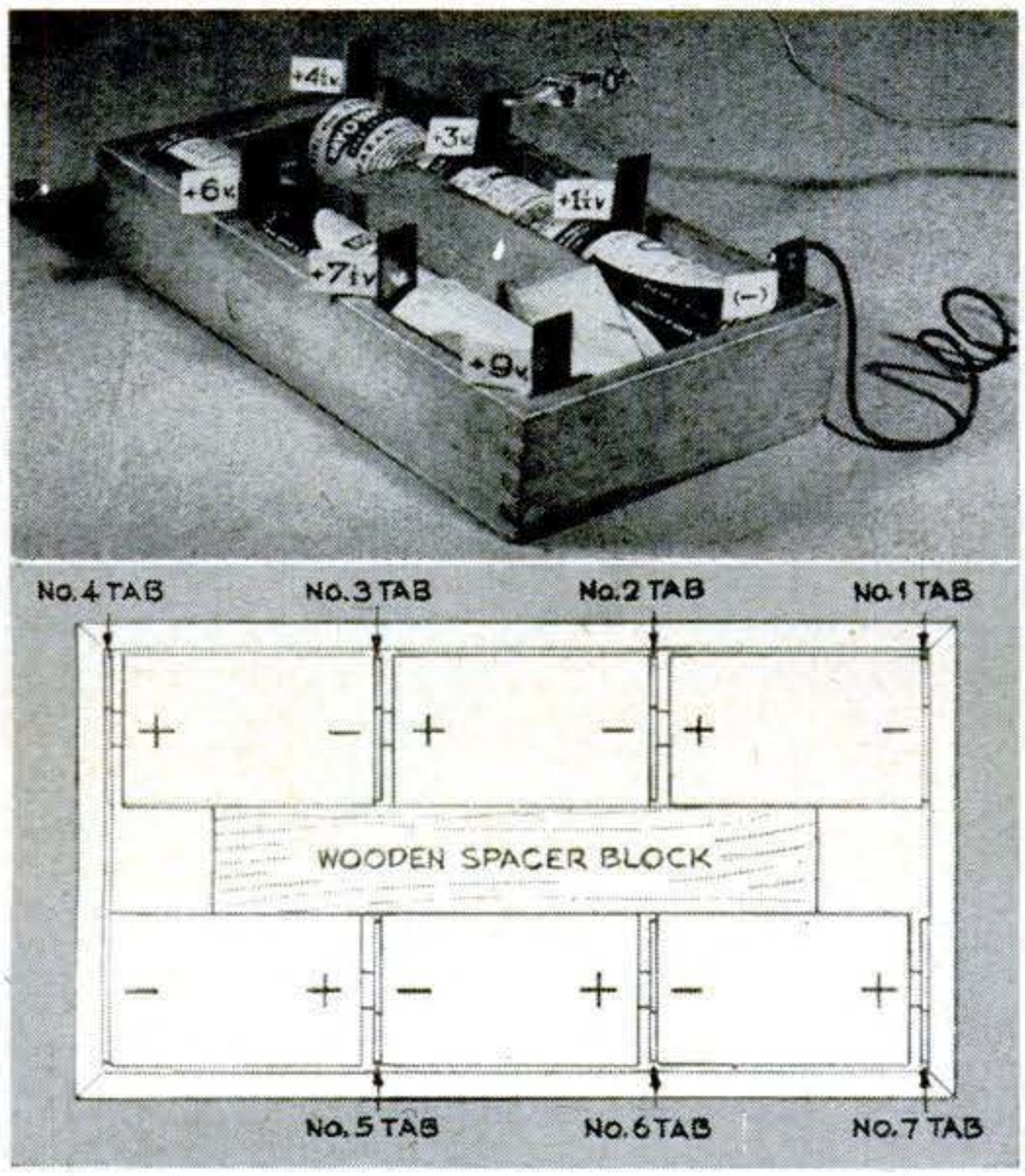
Short Cuts and Tips

"Plumber's Friend" Does Wash

IF YOUR wife refuses to throw oily rags or greasy work clothes in the washing machine, pretreat them to keep the peace. Put them in a bucket or tub with detergent, add hot water and agitate well with a plumber's plunger. When the water is poured off and the items are rinsed, they won't ruin everything they touch.—*Ben C. Dickinson, Warner Robins, Ga.*

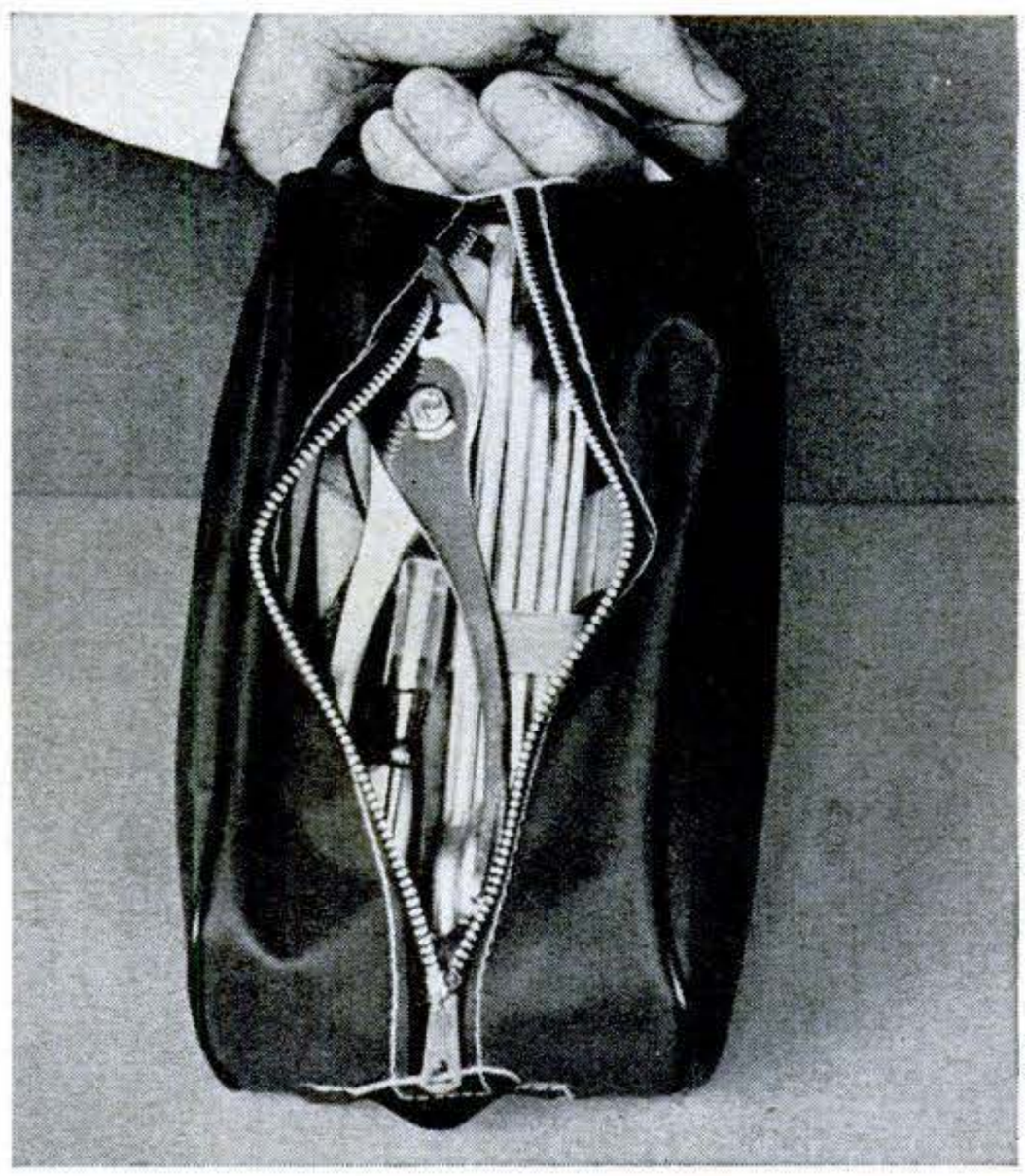


Battery Pack Varies Voltage

THIS battery pack will save time for hobbyists who work with transistors and other low-voltage equipment. To make it, box in six D-size 1½-volt flashlight batteries.

Arrange the batteries to form a six-step series hookup, and insert thin metal tabs between top and bottom of each. At one end of the box, a long metal strip connects the top of one battery to the bottom of the one in the other row.

The No. 1 tab serves as a common negative for six positive taps providing from 1½ to 9 volts. By rearranging the batteries you can make parallel hookups.—*Carlton G. Bucher, White Plains, N. Y.*



Travel Kit Holds Car Tools

ONE of those inexpensive duffel bags with a zipper opening is handy for keeping car tools together. If not too full, it can be folded and bent to fit into an out-of-the-way corner of the luggage compartment. The soft fabric helps prevent rattling, too.—*O. A. Nelson, Seattle.*

▶▶▶RECENTLY while working on a wood project that called for use of fine sandpaper, I found that all I had on hand was a coarse grade. Rather than postpone the job, I dulled the abrasive on the coarse paper by holding it against a grinding wheel. The ground-down paper worked fine.—*John A. Comstock, Wellsboro, Pa.*

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now, in power tools, too,

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Model 149B-¼-inch electric drill; AC-DC; 25 to 60 cycle; 115 volts; 2,500 rpm. At $28.50 — more power per dollar — attachments not included.*

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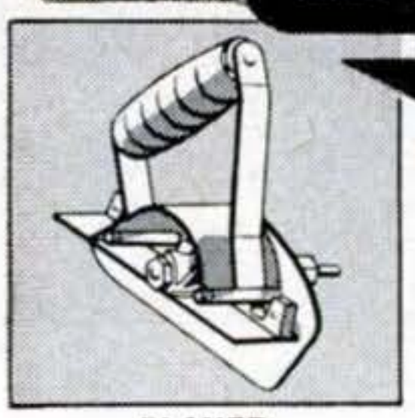
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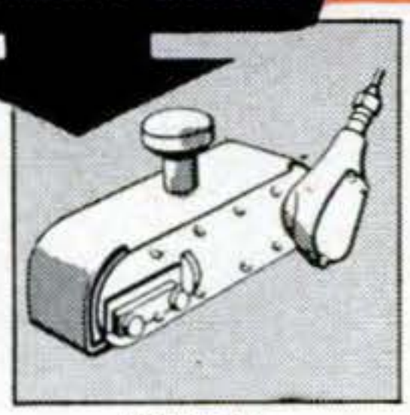
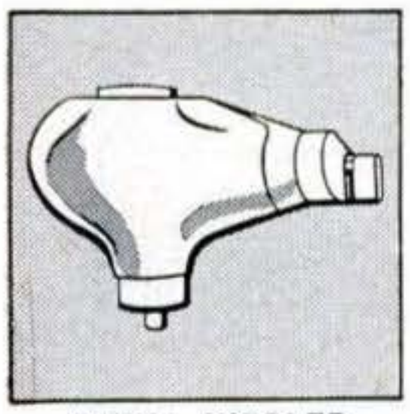
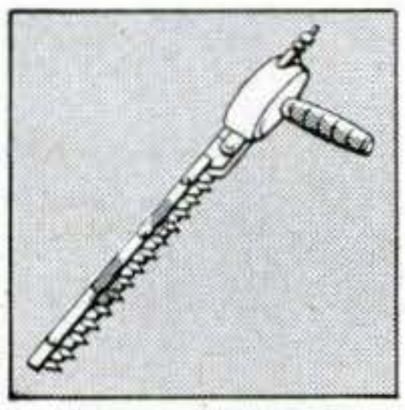
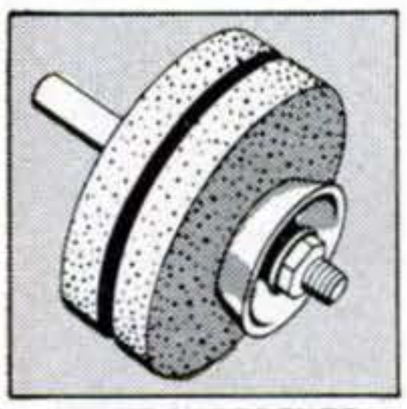

SANDER

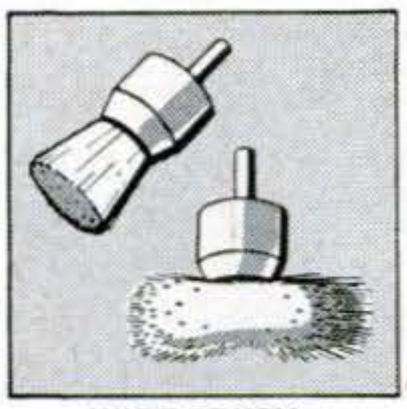
RECIPROCATING SAW

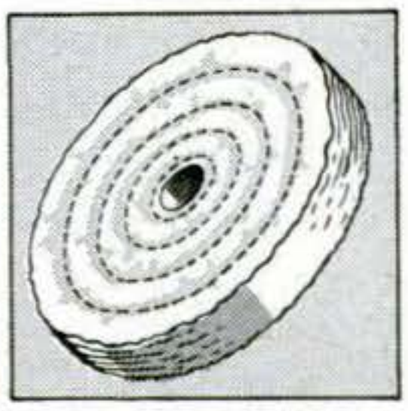

METAL NIBBLER

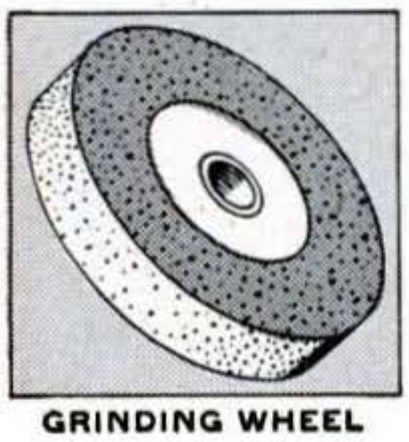

HEDGE TRIMMER

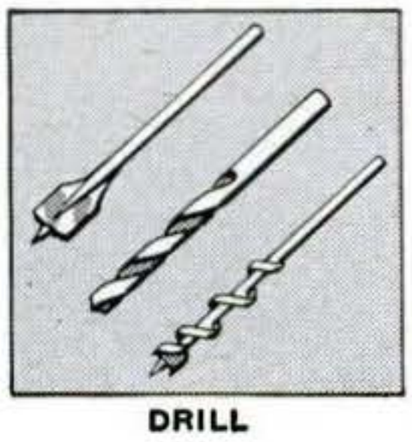
SCREW DRIVER


KNIFE SHARPENER


WIRE BRUSH


RAG BUFF WHEEL


GRINDING WHEEL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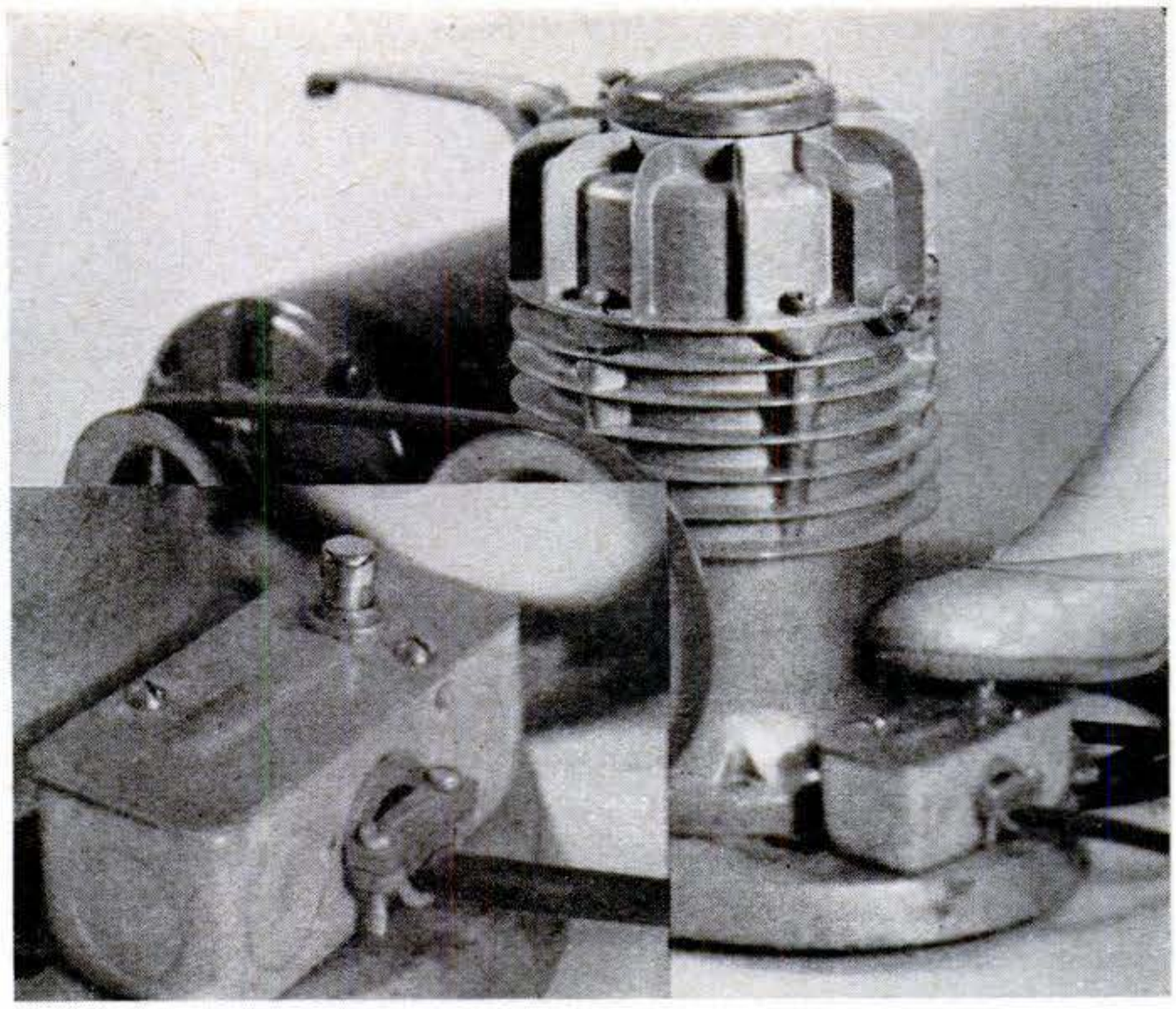
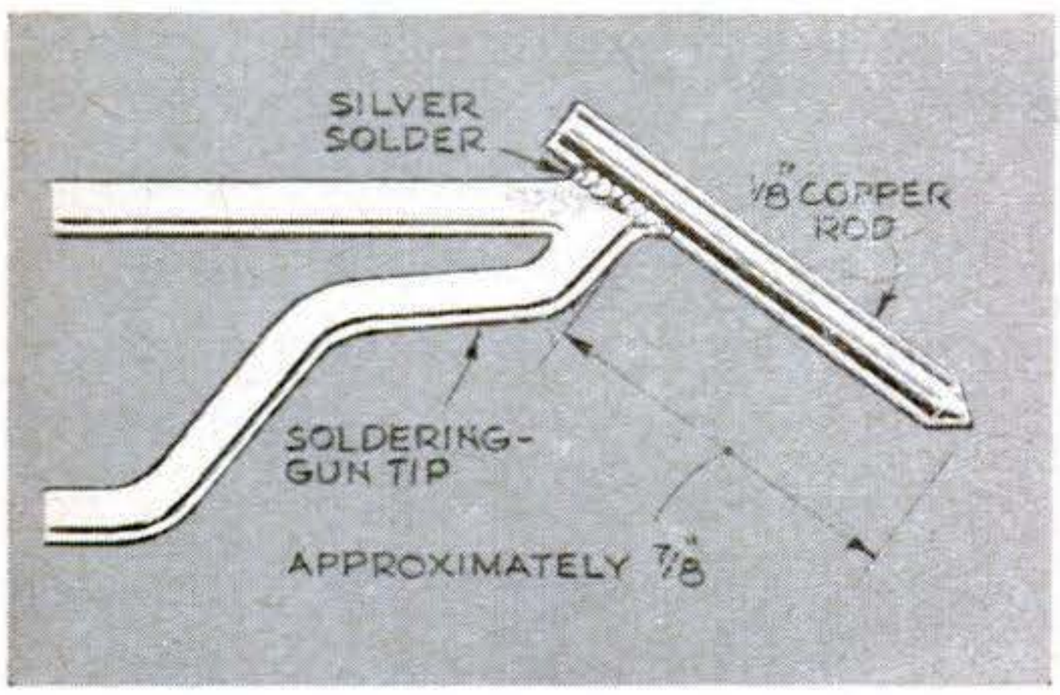
Short Cuts and Tips

Tap of Toe Runs Air Compressor

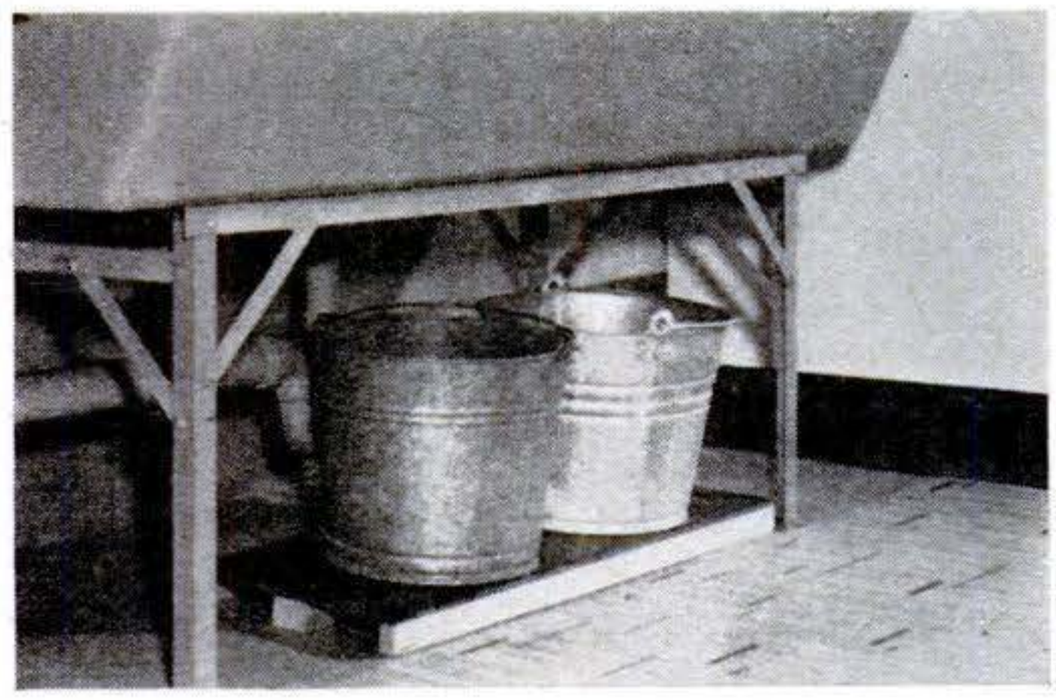
WITH a box and switch that can be purchased at any electrical-supply house, I added a foot switch to my air compressor for more convenient, both-hands-free operation. So far as I know, no low-cost air compressor on the market boasts this simple improvement.—*Joseph S. Restivo, Rumson, N. J.*





Tip Helps Fine Soldering

To USE a soldering gun for printed radio circuits or other fine or hard-to-reach work, silver-solder a 1" extension to an extra tip. I used a piece of flush-valve float rod, but the shank portion of an old tip will do. Either will give the proper heat.—*H. E. Puro, Detroit.*

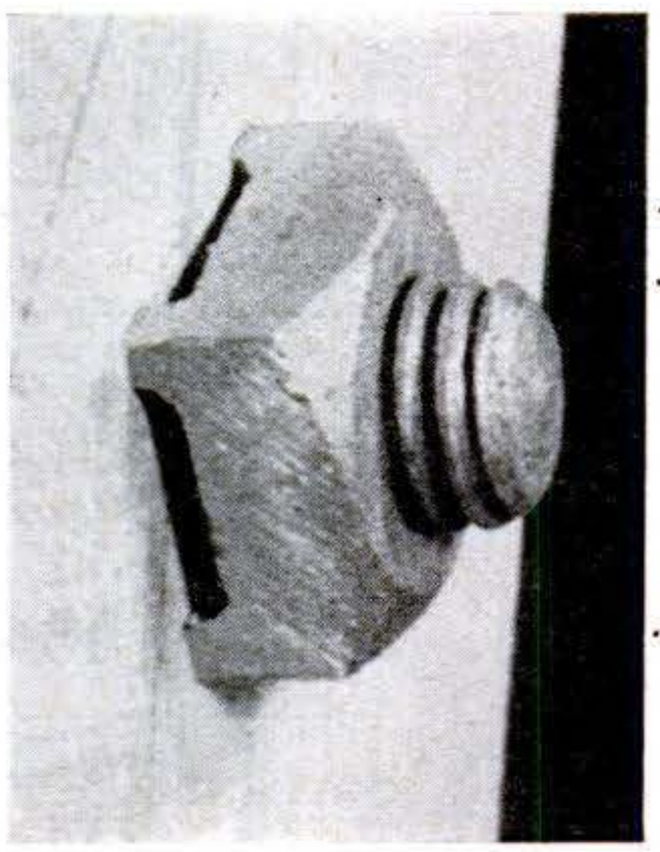


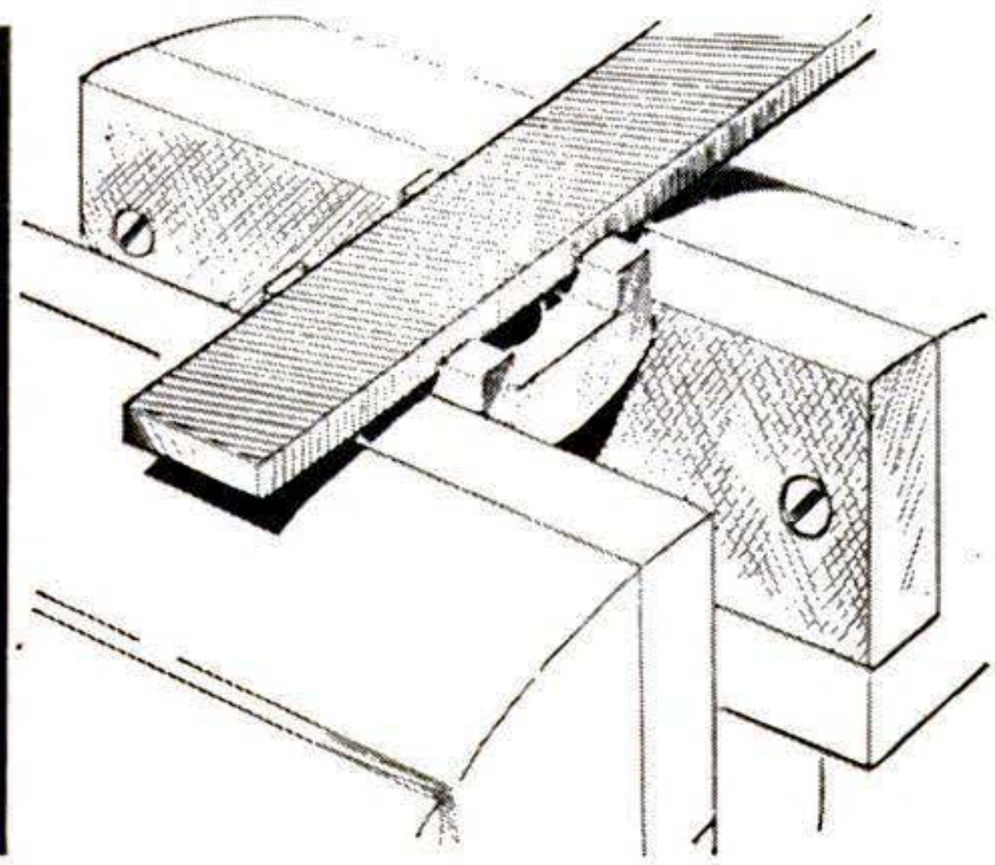
Platform Lifts Wet Pails

BASEMENT floors in a laundry-utility room can be kept drier and cleaner if mop pails are parked on a moisture-resistant platform. I made this one by nailing 1/4" tempered hardboard with slightly beveled edges to a framework of scrap lumber.—*Lawrence H. Selwyn, Chicago.*

Filed Nut Locks in Wood

FILE cross slots on the flat face of a nut and the four corner spurs will penetrate and grip wood when the mating bolt is turned tight. This eliminates the need for a second wrench in tightening a nut. —*R. J. DeCristoforo, Los Altos Hills, Calif.*





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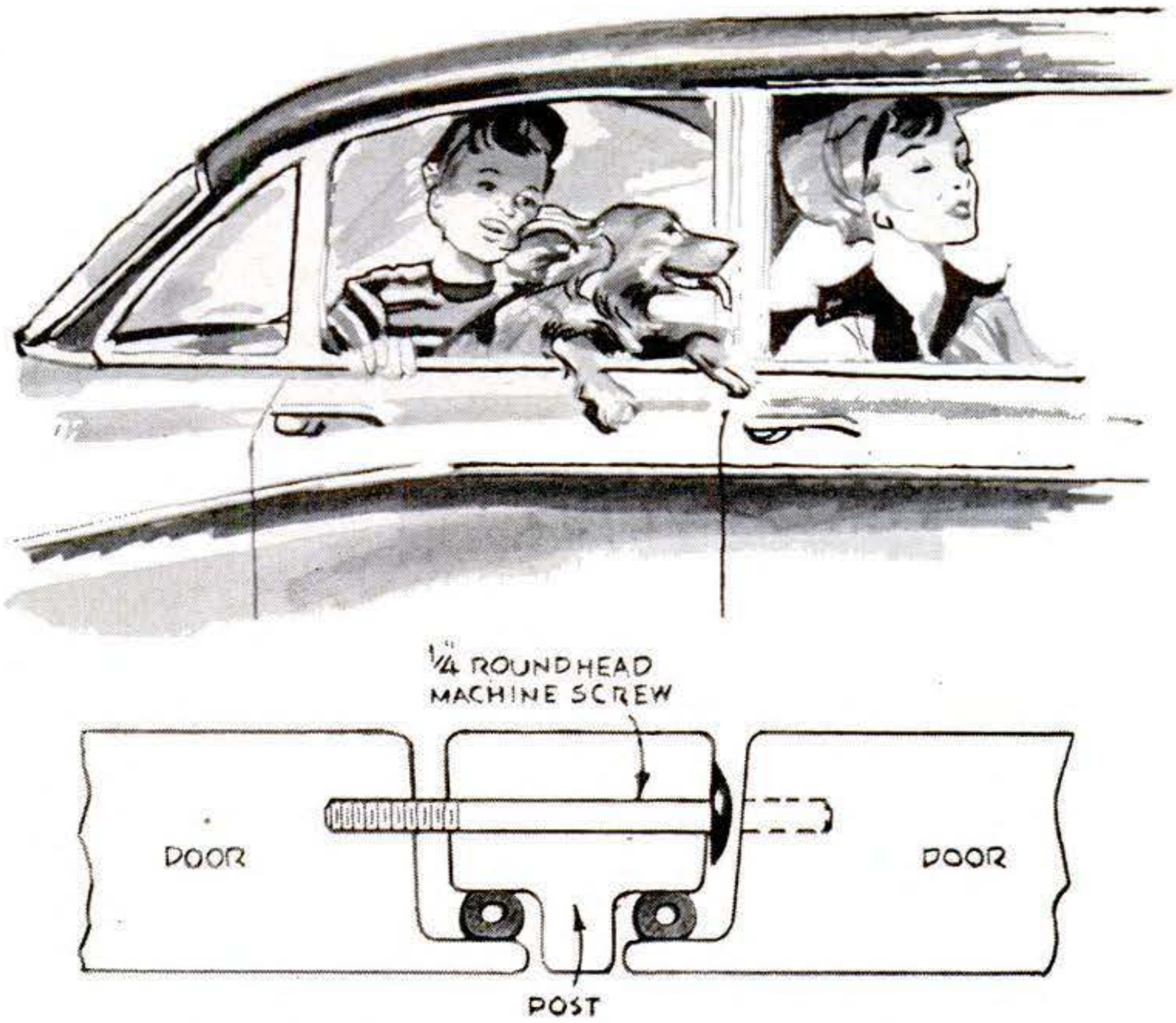
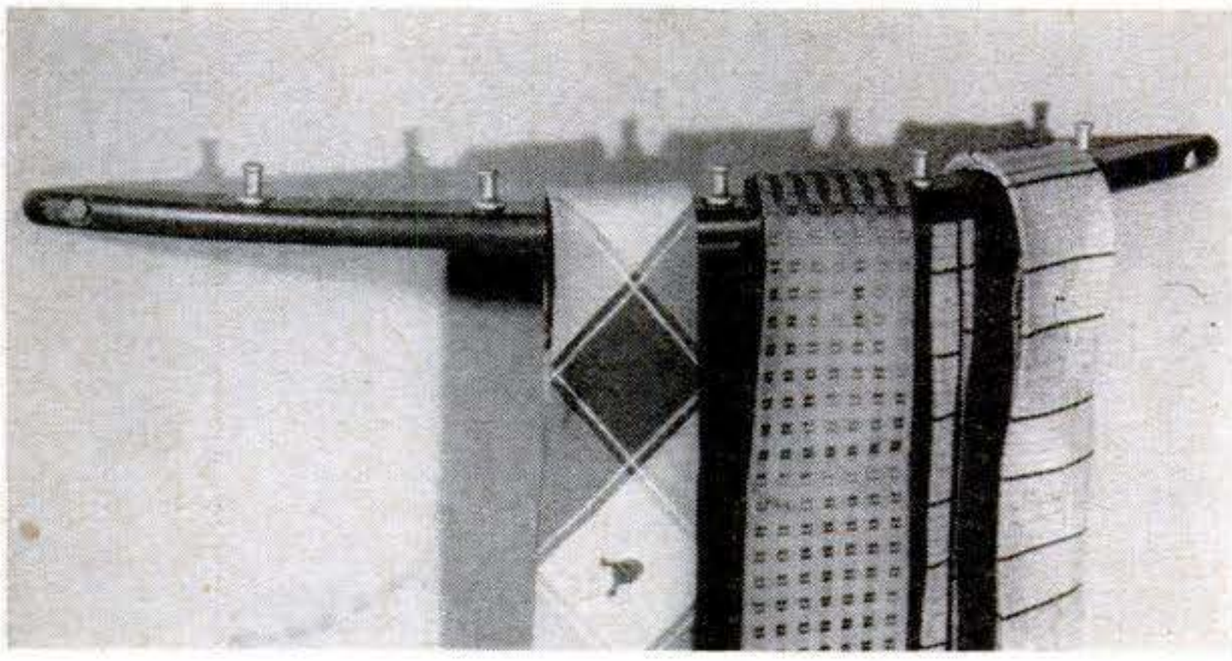


Pins Make Car Doors Safe for Youngsters

YOUNGSTERS riding in the back of a car can be a worry to a driver because of the hazard of opening doors. To give us peace of mind, my husband worked out a simple but ingenious locking arrangement.

He drilled a hole through each center post and into the door facings a few inches below the latch to take a large bolt. When these lock pins are slipped into place, it is impossible to open a rear door until the front door is opened and the bolt is lifted out.

By merely reversing the bolt on the right of the car, we can lock the front door if our young son sits with the driver. The bolts can be removed when not needed and the best part of the arrangement is that the car's appearance is not defaced.—*Jane Reid, Los Angeles.*



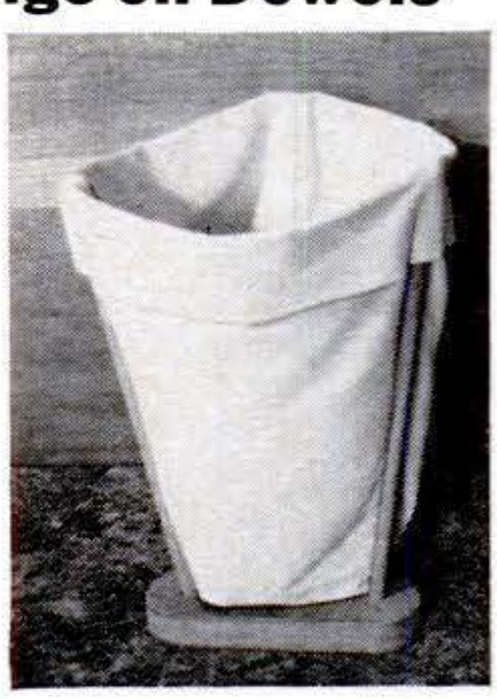
Quickie Tie Rack Made from Hanger

SAW off the ends of a wooden coat hanger so that they can be screwed flush to a wall or door, and you have a good tie rack. Remove the wire hook, plug the hole with wood filler, enamel the rack to harmonize with its background, and stud with push-pin dividers.—*Frank Shore, NYC.*

Ball Lifts Out Broken Light Bulb

SHATTERED glass makes it dangerous to remove a broken lamp bulb from its socket with your fingers, and it's difficult to turn the shell with a pair of pliers. A better tool for the job is a small rubber ball. Press it up against the bulb and you can twist out the remains safely and easily.—*M/Sgt. J. R. Wood, APO, NYC.*

Litter Basket Hangs on Dowels



A FABRIC bag that matches the drapes or upholstery makes an unusual wastebasket for a bedroom or den. Three pockets, sewed into a hem at the top, slip over ¾″ dowels set in a 2″-thick triangular base. When filled, the bag is lifted off the stand, dumped and rehung on the dowels.—*R. P. Loewen, Anniston, Ala.*

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How to get your money's worth from the next battery you buy

Although most batteries look alike, there is a vast difference in the way they perform. So, it will pay you to choose your next battery carefully rather than just "buy a battery." There are good reasons why it will pay you to choose an Exide.

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FREE! *This 32-page manual tells all about batteries. How to test, install, recharge, etc. Write to Dept. 36, Exide Automotive Division, P.O. Box 6266, Cleveland, Ohio.*

When it's an Exide . . . YOU START

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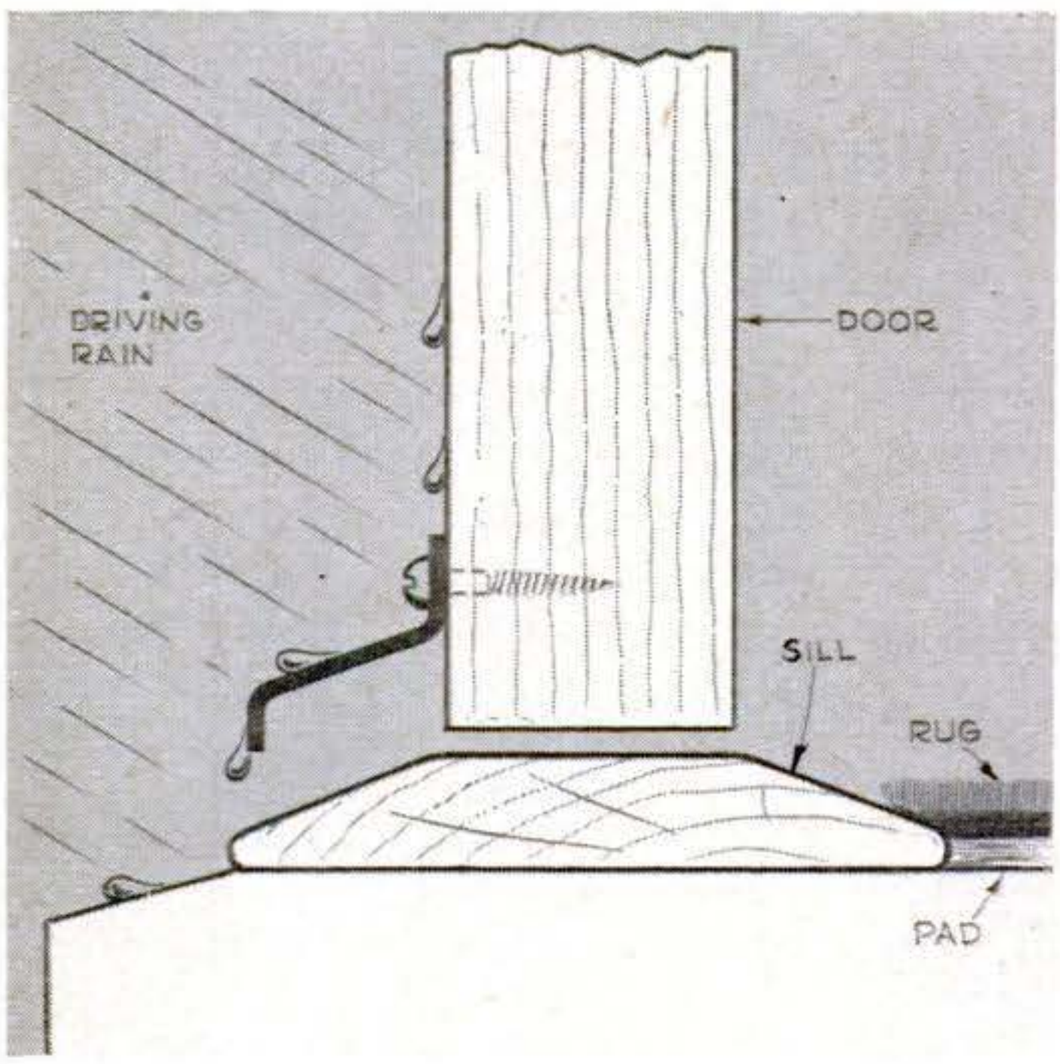
Short Cuts and Tips

Lunch-Box File Holds Bulky Papers

WHEN household papers overflowed a small file-card box, I moved them into an unused lunch box. Now I can store dozens of receipts, notices and other papers in this dustproof file. It's long enough to hold legal-sized envelopes and has a handle. —*H. W. Swope, Danville, Pa.*

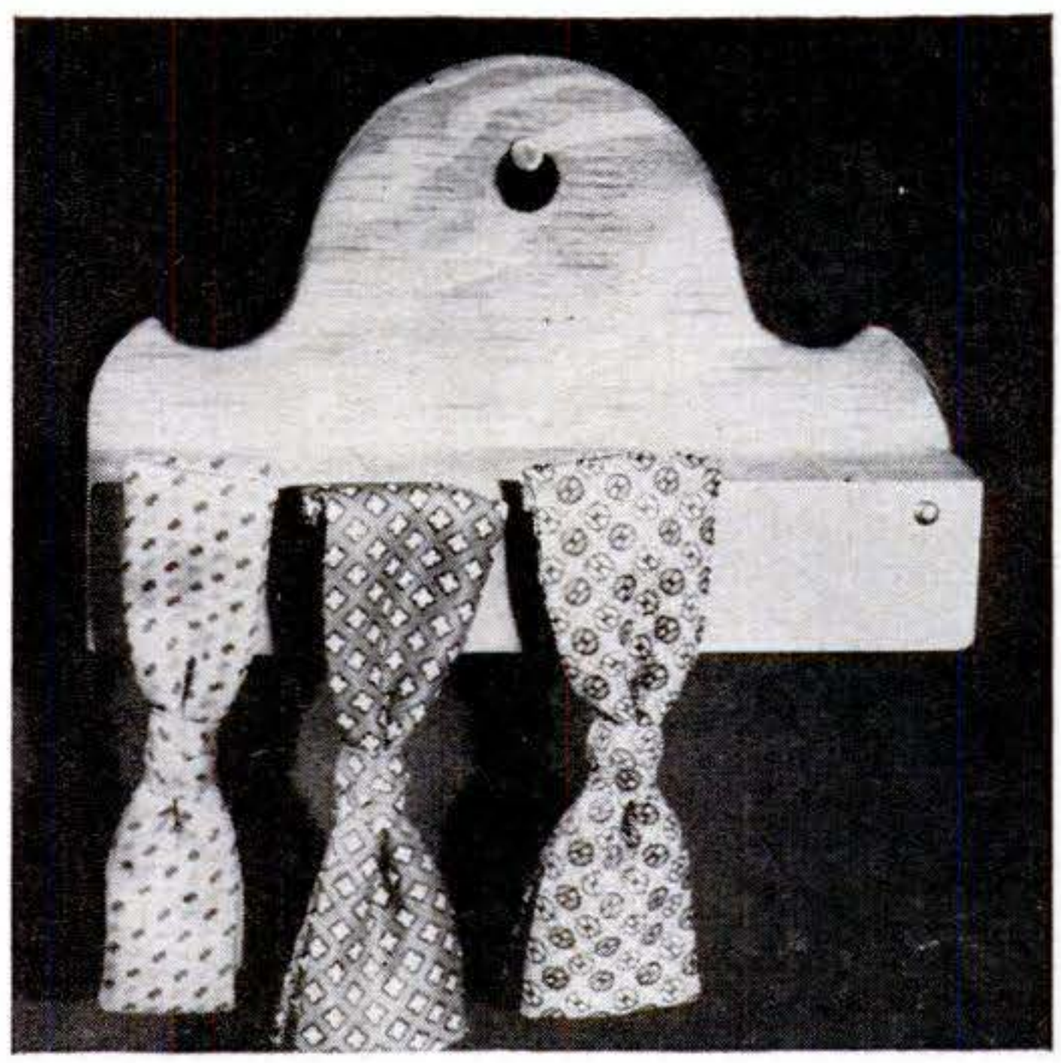
▶▶▶AN OLD screwdriver makes a handy tool for drilling through concrete, brick or thin wood. I drill wood by pushing the screwdriver blade into it with a twisting motion. On concrete and brick I start my "drill" by rapping the handle with a hammer.—*Charles Carroll, Marion, Ohio.*

▶▶▶BEFORE painting over a screw that you may want to remove later, back it off a few turns and let the paint dry. Then retighten. This way paint won't seal the screwhead in tight, or be marred if you decide to take the screw out later.—*Kenneth F. LeMere, Springfield, Mass.*



Deflector Keeps Rain Outside

RAIN water can't run under my front door and onto the rug since I added a deflector. Bent from a strip of aluminum, the deflector is screwed to the bottom outside edge of the door with aluminum screws. It cuts down on drafts, too.—*A. Di Stasi, Trenton, N. J.*



Clip-On Rack Holds Bow Ties

ALL the tie racks I've seen ignore ready-tied bow ties, so I made my own of 1/4" plywood. I nailed a 1/2"-wide strip of plywood across a backboard and faced this with a 1"-wide strip of aluminum. The tie clips grip the metal overhang at the bottom.—*A. R. Tanner, Cold Spring, N. Y.*

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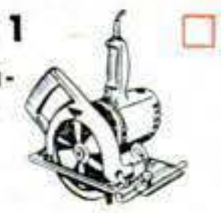

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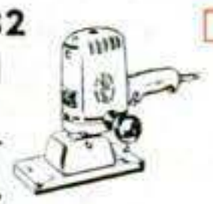

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[Continued from page 104]

above 60°, now averaged 67°.) Despite the flying spray and occasional water on deck, men were painting everywhere in the endless fight against rust.

On Sunday, as the ship neared Lands End, the approach and English Channel charts were brought out. The chief mate drew a black circle around a seven-fathom spot that could rip the ship's bottom. At 1530 she detoured around it. At 1650, the ship changed course again to pass the first of a group of fishing trawlers. Ocean traffic was getting heavy. Before leaving the bridge, Meseck took radio direction-finder bearings. His plot showed the ship right on her track.

Before turning in, though, the captain left a call for 0300. He wanted to be on the bridge for the first visual landfall.

The loom of Bishop's Rock light was sighted at 0348; at 0426 the lighthouse itself was visible. The trip was over.

As the ship steamed through the English Channel, working parties were laying out the heavy mooring lines. In mid-afternoon, the captain raised the pilot cutter on the radiophone. "Tanker World Beauty calling," he said. "Arrive at 1900."

"You will not be docking tonight; you will anchor in Cowes Roads," the cutter answered.

Coming up to the World War II flak tower where the pilot boat waits, the captain tried different maneuvers to see how the ship handled under a full load. Her weight was nearly 60,000 long tons, or roughly the same as a bumper-to-bumper line of ordinary passenger cars more than 100 miles long. He stopped the engines. After drifting 3½ miles, the Beauty was still making half speed. "She goes farther than I thought," he said wryly.

There was more to occupy the captain's mind when the pilot came aboard. He explained that the Beauty was too big to take upriver—Fawley is on the Test River—in the dark.

Next day, Tuesday, there was further trouble over size. Alongside the oil dock there was a shoal spot that would come right under the Beauty's stern. Because of her draft, she'd be aground at low water, although she could get in all right at high tide. To complicate matters, the

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Star of the Forward Look... Fury by Plymouth

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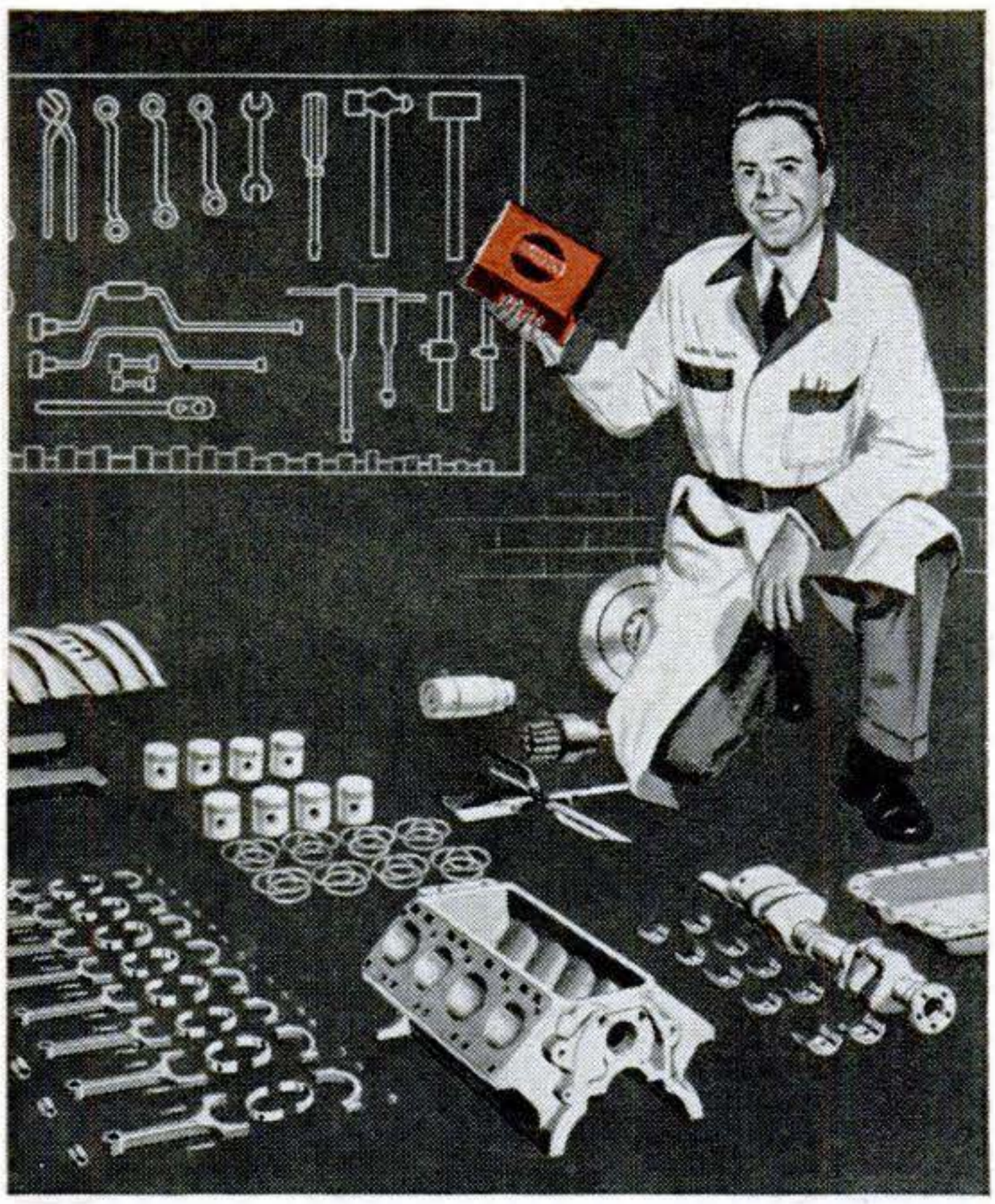

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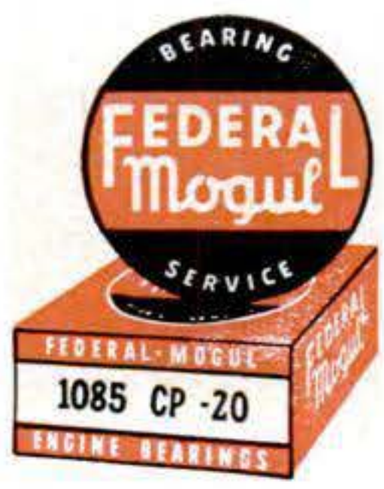

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The Dangerous Job of Moving Oil

refinery wanted only the premium crude, stored in forward tanks. Unloading it would not raise the tanker's stern.

To keep her off the bottom, the refinery would have to take 6,000 tons of the other oil—which was all they had room for. It would be a close race to lighten the Beauty before the ebbing tide dropped her on the bottom.

Wednesday afternoon, as the tide was rising, the World Beauty headed upstream. At 1750 she was moored. There was one hour to flood tide—6½ hours to low water.

Within 15 minutes two hoses were aboard. Within half an hour, four were hooked up. At 1855, Meseck yelled down to the engine room to start the pumps.

Things went wrong. The pressure gauges on one line read too high. Poomps discovered a supposedly open valve that was half shut. It took two oversize wrenches and two strong backs to fix it. The gauges on another line ceased functioning, and finally, the reduction gears on pump No. 4 overheated so the pump had to be shut down. That left only three pumps in the race.

All night long the pumps whirred and the men with steel ullage tapes walked from tank to tank. At 0010, a little before low water, Meseck figured he had enough of the ordinary crude off the ship to keep her clear of the shoal. At 0401 he stopped the main pumps. Now the ship was racing not the tide but another ship. Tugs had been ordered originally for 0600, but the Queen Elizabeth was sailing from Southampton that morning, too. The tugs said they'd have to leave the Beauty for the Queen at 0550.

At 0531 the last man from the refinery jumped from the tanker's deck two feet to the pier. Then, in the gray light of a rainy English morning, the lines were snaked in and the tugs pulled the World Beauty away from the dock. She blew her whistle as she headed downstream, riding high enough now to enter Rotterdam to leave the rest of her crude oil. From there, she was bound for the Persian Gulf for more oil.

Her first year would take her nine-tenths of the way around the globe, traversing the world's major oceans, shuttling tirelessly from oil field to civilization and back. END

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NEW Dremel Deluxe MOTO-SHOP

COMPLETE POWER WORKSHOP IN ONE COMPACT, PORTABLE UNIT

The amazing new Dremel Moto-Shop is the most versatile multi-purpose tool ever invented. Has 1,001 home and shop uses. Basically, it's a 15" Jig Saw with a unique power take-off to which you simply connect other attachments.

It then converts to a disc sander, bench grinder, buffing wheel, and a flexible-shaft machine . . . all powered by a ball-bearing rotary motor.

And this professional-quality, portable power shop can be set up practically anywhere—basement workshop, kitchen counter, or card table. Weighs only 12 lbs. As a Jig Saw, it will cut 1¾" wood, 18 gauge copper, 1/16" steel—all with the same blade. Foolproof blade guard makes it absolutely safe—even for children. Handles everything from birdhouses to full-size furniture.

The flexible-shaft is a complete machine shop in itself. Use it for sharpening, grinding, polishing, carving. Collet capacity 1/64" to ⅛".

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Model 57 Moto-Shop. Includes Jig Saw with disc sander attachment only. Other attachments can be added later. **$33.95**

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Price of attachments only, if purchased separately. . . **$19.95**

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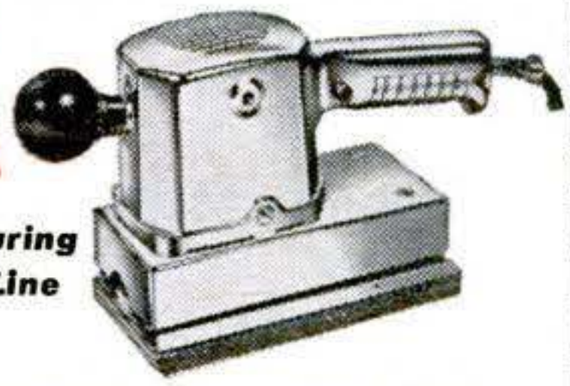

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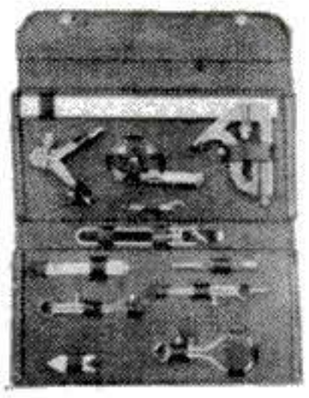

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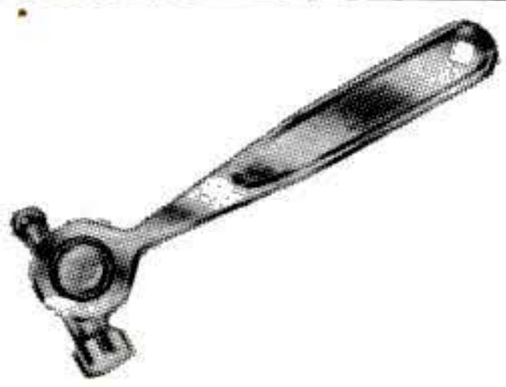

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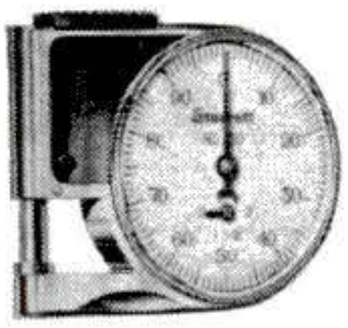

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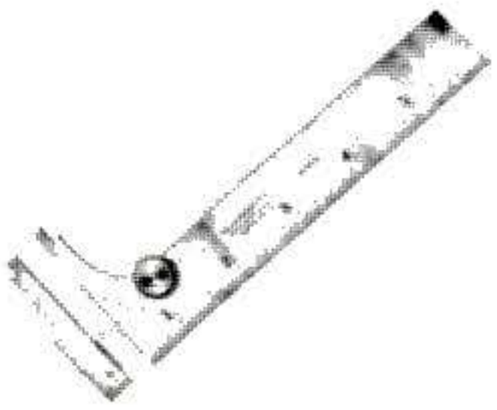

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The '58 Ford—How It Stacks Up

[Continued from page 79]

Chevy's three-carburetor combination works with deceptive simplicity. The fore and aft carburetors cut in only at a considerable throttle opening—50 degrees, as the engineers describe it. Most of the time, even in the car's cruising ranges, the engine uses only the single center carburetor.

When a driver wants more oomph, as in getting away from a light or in passing, he hits the accelerator hard. That taps a vacuum line normally used as a booster for the fuel flow. Piped to a diaphragm at the front carburetor, it unloads a spring that holds the butterfly valves closed. That's all—except that the rear carburetor is linked mechanically to the front one.

On a cold start, the choke locks out all but the center carburetor.

Many changes besides those described in November PS (p. 105) have been made in Chevy's fuel-injection system.

It operates on a leaner mixture. Air leaks around the nozzle anchorages have been sealed off. Dirty fuel can stopper a fuel nozzle like a cork. Purity is assured by backing up a general fuel screen with tiny screens in each nozzle. (Maintenance memo: These screens do *not* have to be cleaned, says Chevy.)

A Rube Goldberg arrangement for cold starts—a solenoid to increase fuel flow, plus a microswitch to bypass it for hot starts—has vanished. In its place is an enrichment valve operated simply by manifold vacuum.

The principle is simple: On a cold start with a stiff engine, there's a high cranking vacuum; on a hot start with a free engine, less. A diaphragm that meters and enriches the fuel responds accordingly.

Incidentally, for competition, a hot cam boosts the Corvette's 283-inch fuel-injection engine to an incredible 290 horsepower.

The new Chevrolets, bellwethered by a romantic number called the Impala—which is right out of the pages of the Arabian Nights—are *nine* inches longer and almost four inches wider. The height, inevitably, has tobogganed by almost 4½ inches. The hood is an inch shorter, the deck lid nine inches longer.

Yup, air springs. You don't *have* to

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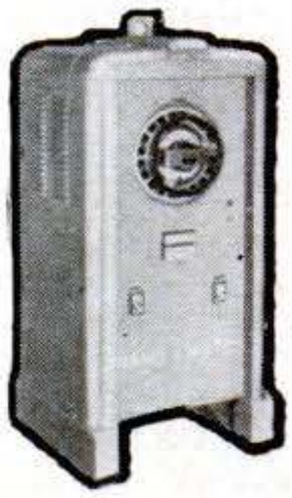

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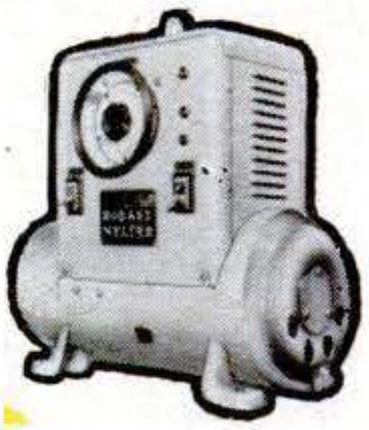

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have them, of course—they're strictly optional.

PLYMOUTH

Plymouth for 1958 is just what the customers might expect of a vehicle that has changed its look only modestly. It offers performance. Its "bomb" power plant, available on *any* Plymouth model, has not one but *two* four-barrel pots, a dual-exhaust system and a dual-breaker distributor.

All this has required commensurate changes: a heavy-duty generator, beefier springs and shock absorbers, and a heftier cooling system. The company's word jugglers call their 10:1-compression-ratio engine the Golden Commando.

The Fury engine of 318 cubic inches, a topic for discussions 'round the cracker barrel in 1957, can still be had, even if old-hat now. It has undergone some refinements. A two-barrel carburetor is standard; a four-barrel with dual exhaust, special timing and high-performance cam is optional. For *all* Plymouths, too.

There's eight-barrel carburetion on this engine for Plymouth Fury models only. And for the man who just wants good transportation, the flathead six is still around.

The Bendix fuel-injection system (PS, Mar.) can be had only on the big engine. The Chrysler Corp.'s limitation on this option is evidence to Detroit's professional seers that Chrysler will announce its own system before long. And, breathless and hot-palmed from its own research in this field for three years, so will Ford.

Plymouth's three-speed automatic transmission now comes as an option on all models as an answer to Ford's refined box and Chevrolet's silky Turboglide.

Plymouth's body measurements are mostly unchanged from '57.

That resolution adopted last June by Detroit's tycoons recommended that automobile manufacturers "not advertise or publicize actual or comparative capabilities of passenger cars for speed, or specific engine size, torque, horsepower or ability to accelerate or perform, in any context that suggests speed."

They won't, either. But Detroit's "bombs" for '58 would seem to imply that the engineers on the working level never got the word. END

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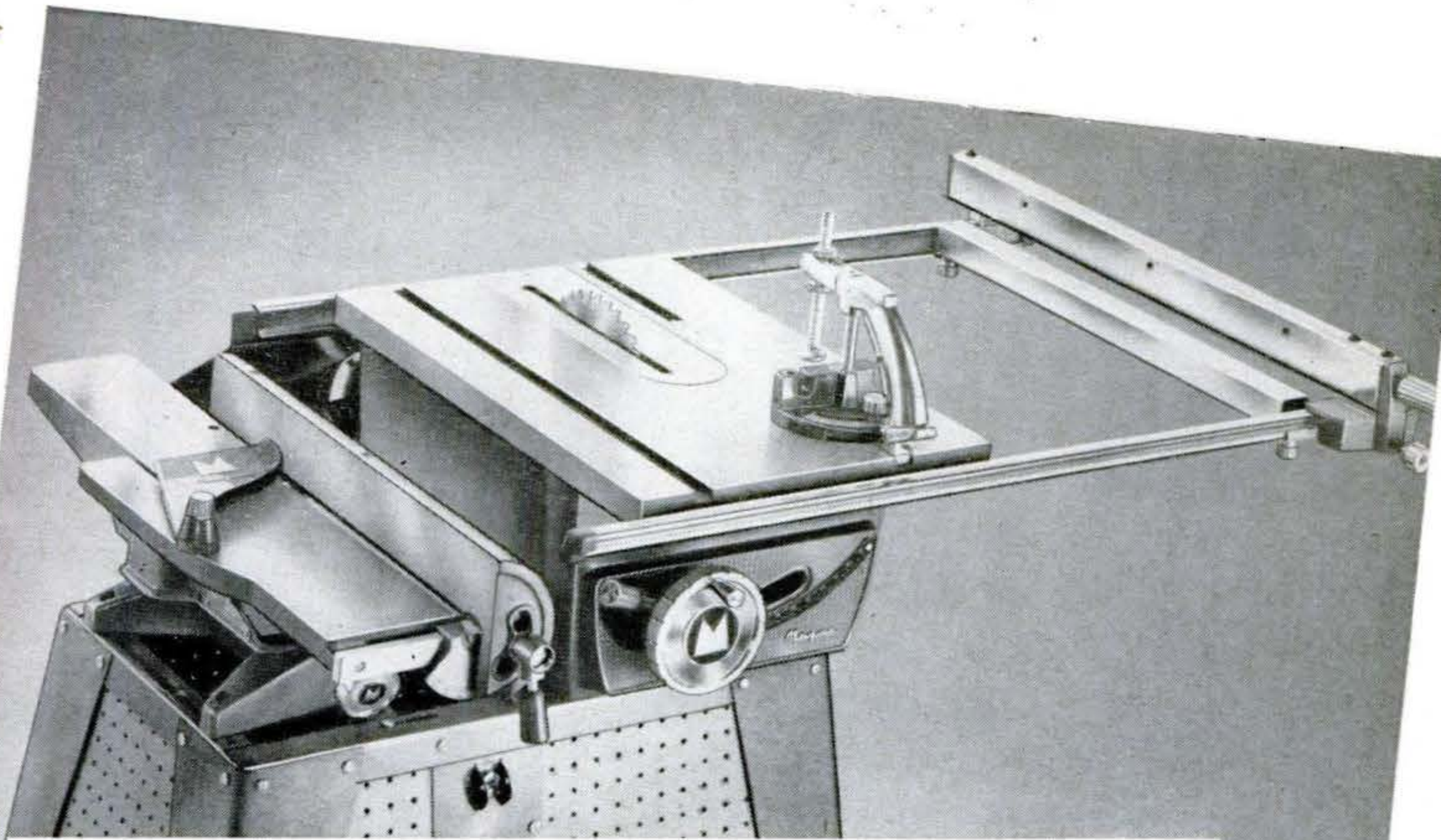

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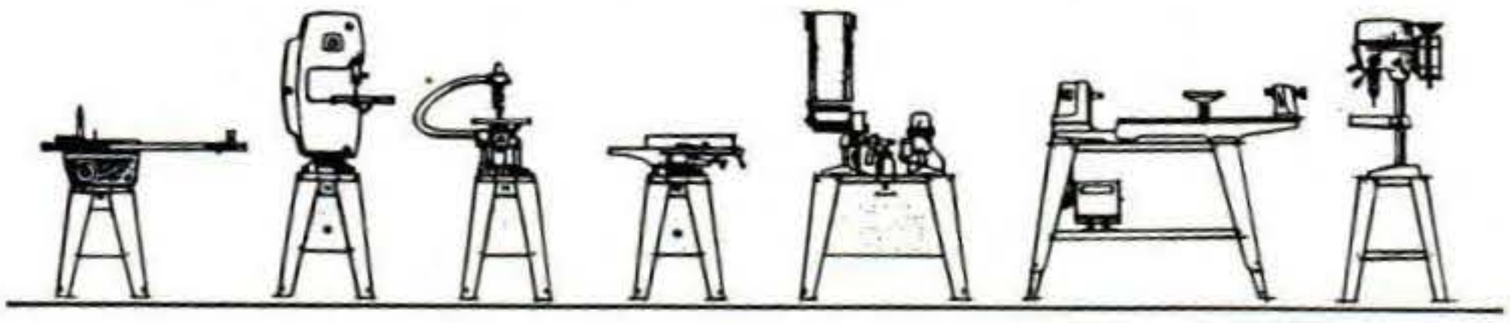

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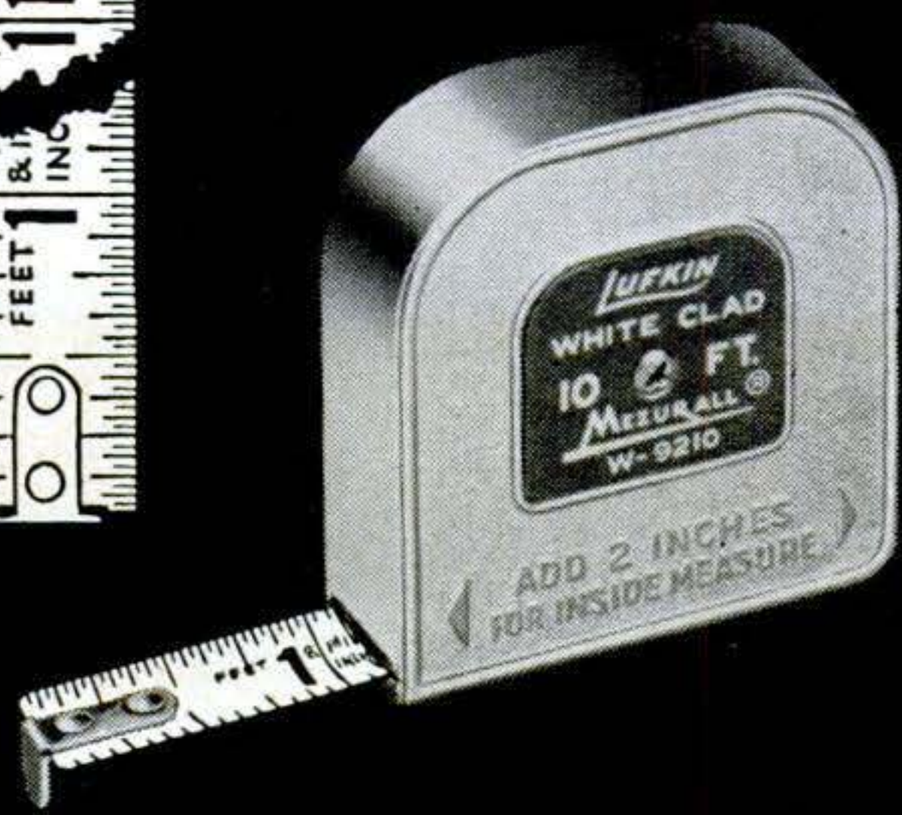

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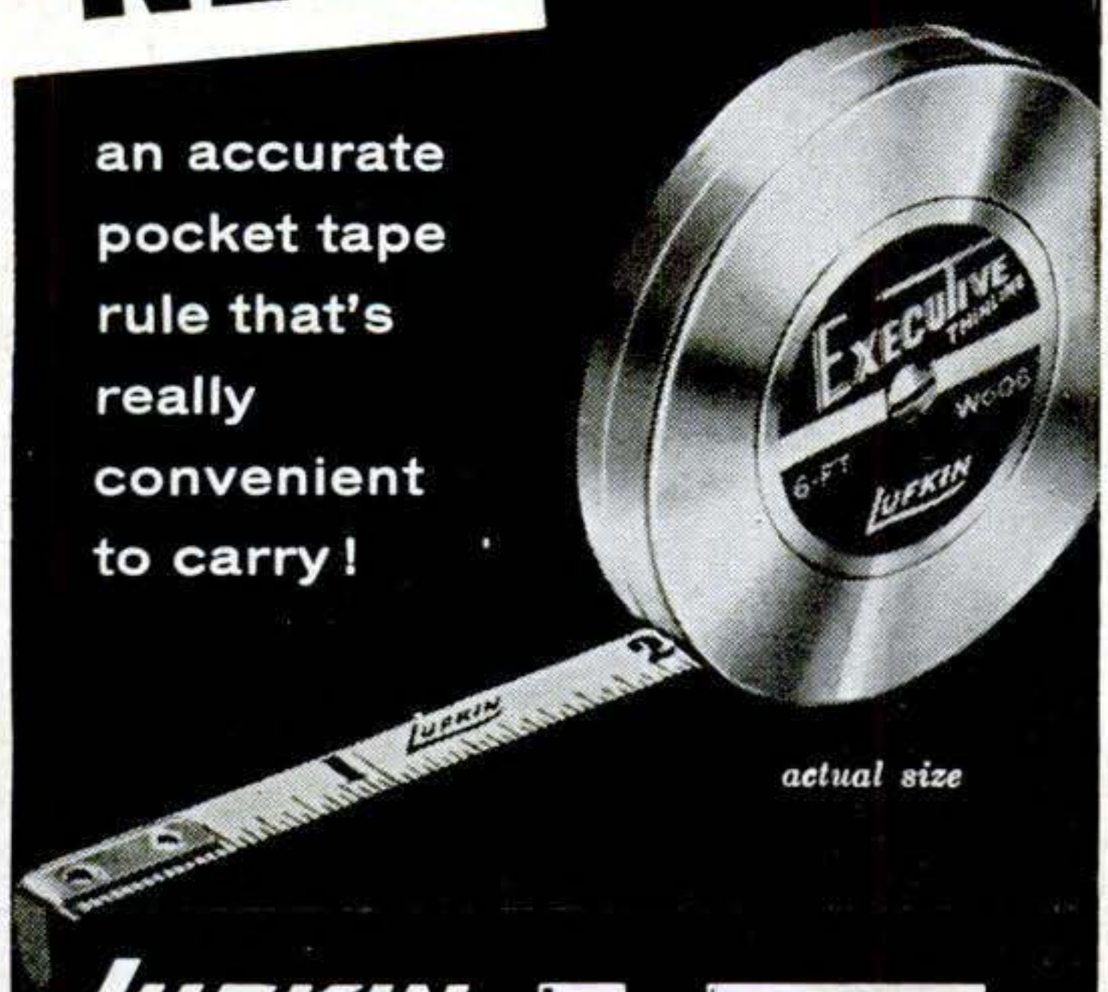

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How Good Are Your School's Shops?

[*Continued from page 115*]

these six states, you can get more information by writing to the supervisor of vocational education in the state department of education.

In the other 42 states, the pattern varies widely. Your best bet: Talk to the guidance director or principal of your local high school.

Suppose there is no vocational-training program in your area? Can you get one started? The people in suburban Nassau County (N.Y.) did.

Four years ago Nassau school authorities enlisted 2,000 volunteers to get the facts on the need for a vocational school. This volunteer brigade surveyed 26,000 people—parents, students, employers, plain taxpayers. They found:

- Half the county's skilled workers were being imported from other areas, although the county's population was 1,000,000.
- One out of five students in the upper grades favored vocational training.
- Three out of five parents wanted a vocational program.

The survey brought results. Nassau County is going ahead carefully but swiftly: This fall 80 boys enrolled in the county's brand-new "pilot" school to study electronics and air conditioning.

Judging your school. In considering vocational training, remember that your son can choose among several ways of learning a trade (other possibilities: post-high-school technical institute, apprenticeship). So you should look long and hard at your vocational school to make sure that it gives the kind of training your son will need.

You can judge the quality of this training yourself, simply by visiting the school and by talking to teachers, graduates and employers.

The experts I interviewed suggested six points to keep in mind:

1. Students. Are they boys who want, need and can use the training? Or is the school a dumping ground for misfits?

2. Teachers. They should be masters of their crafts, and educators as well. Connecticut requires eight years' industrial experience, 60 hours' teacher training. Qualified guidance counselors are essential.

3. Facilities. The shops should have up-

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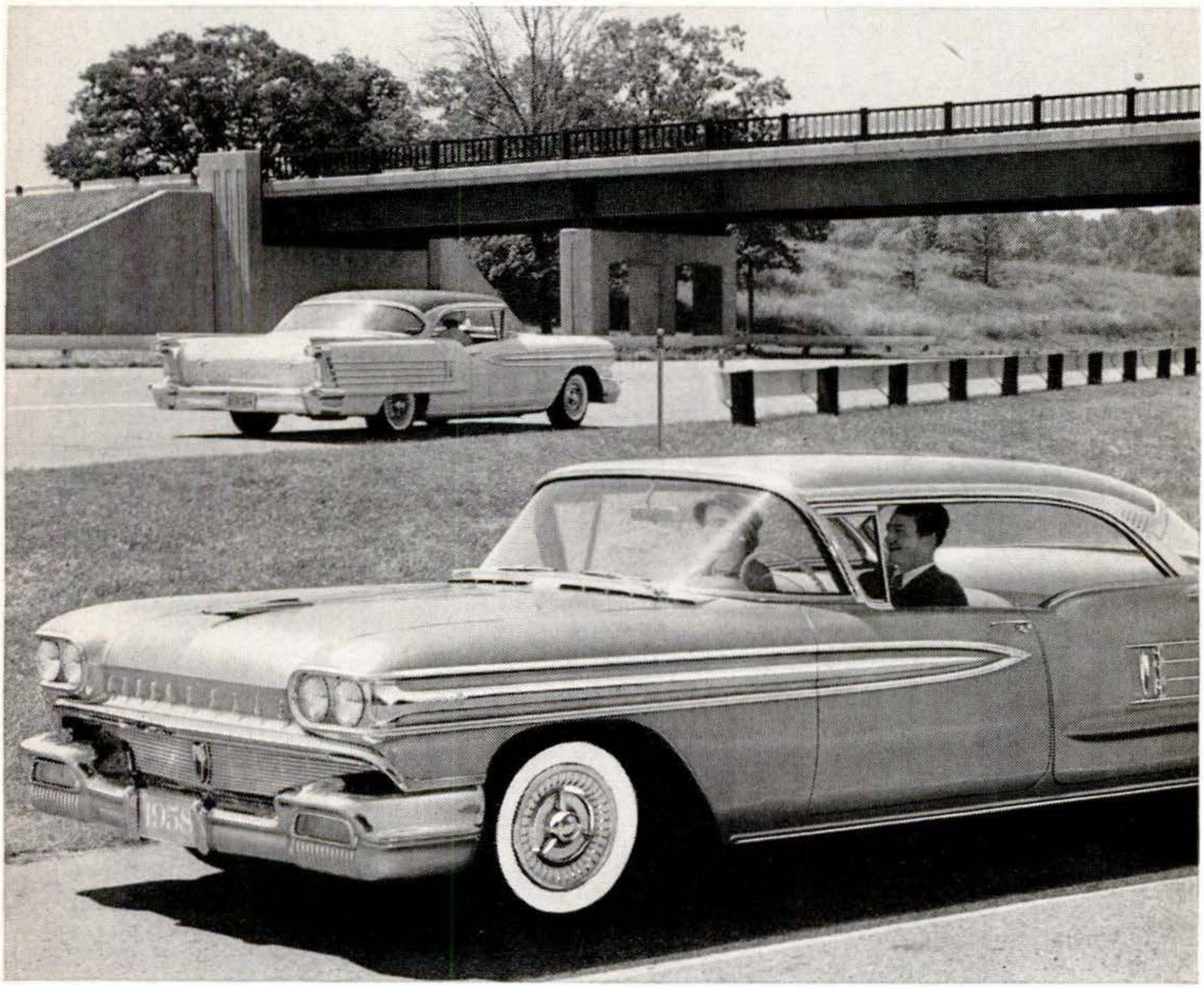

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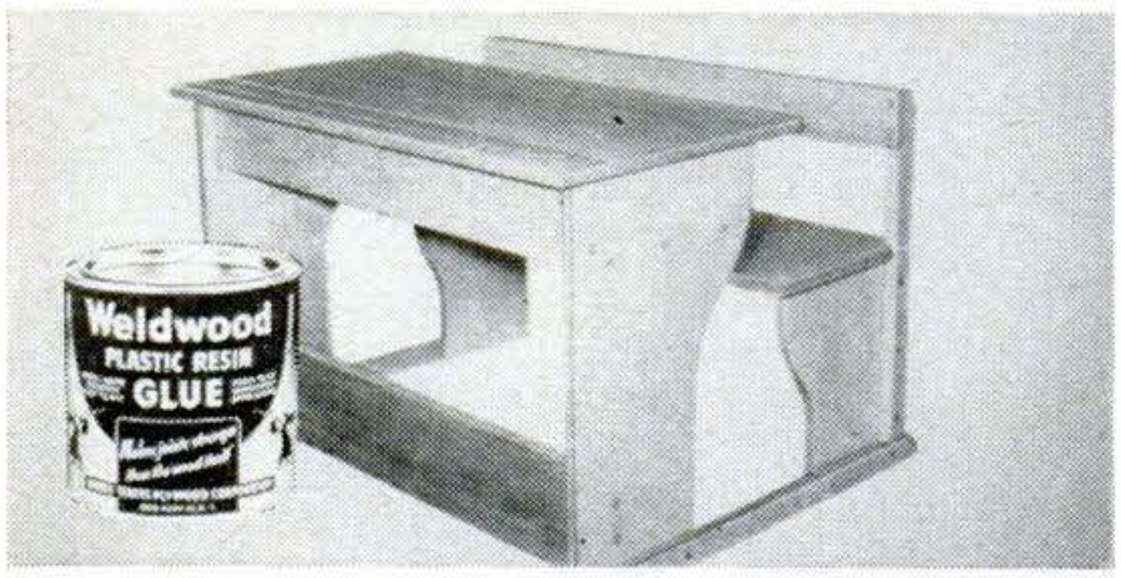

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to-date tools and machines similar to those actually used in industry. To help you judge the adequacy of the investment, one rule of thumb is the experience of two recently built schools. They cost $3,000 per student for buildings and land, $1,000 per student for equipment.

Understandably, schools move slower than industry in adopting new types of equipment. Even the best may be five or 10 years behind. Two outstanding systems —in Milwaukee and Connecticut—for instance, found recently that printing firms needed offset platemakers and pressmen, but the school print shops had no offset equipment at all.

4. *Courses.* They should be slanted toward local needs (in Iowa, truck and tractor mechanics would be in demand, but foundry workers would not); they should be up to date (aircraft mechanics need training in jet as well as piston engines); and they should be extremely practical, imitating as closely as possible actual working conditions on the job.

5. *Academic education.* These days, a craftsman can't get by just with his hands. He has to know English, math and history, too. Vocational schools devote less time to these subjects than the general high schools, but the good ones turn out educated citizens prepared to make their way in the world.

6. *Activities.* Vocational students deserve them, too—sports, dances and the rest of the fun and excitement that go with an American high-school education.

Where schools that measure up to those standards are available, everybody gains. Employer and employee groups say so in concrete terms: better jobs.

Among the Nassau County businessmen who answered the school survey, two-thirds of the manufacturing firms and three-fifths of the trade and service companies gave the inside track for jobs to applicants with vocational training in high school.

The union viewpoint? A remark by Joseph M. Rourke, secretary-treasurer of the Connecticut AFL, is typical. He said: "If I had my way, before anyone was allowed to accept apprenticeship in the union of which I am a member . . . he would have to be a graduate of a vocational school . . . or have had equivalent training." END

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These men chose before enlistment— so can you!

Pvt. Floyd E. Van Briesen
Brookings, South Dakota
Graduate, School of Agriculture

"I picked my own Army job training, and it was guaranteed for me *before* I enlisted. I chose a fine Diesel Repair course. My instructors were really good, and the training equipment was the best you could find. Now I'm an expert in diesels. I found only the Army offers a deal like this."

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Bouler, Wisconsin
Graduate, Bouler Union Free High school

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Seniors—get all the details on how high school graduates can choose their technical training before enlistment from 127 modern courses. Mail this coupon for your free booklet today. Or for immediate counseling visit your local Army Recruiter. He's listed in the phone book and will give you all the facts—at no obligation!

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Washington 25, D.C.
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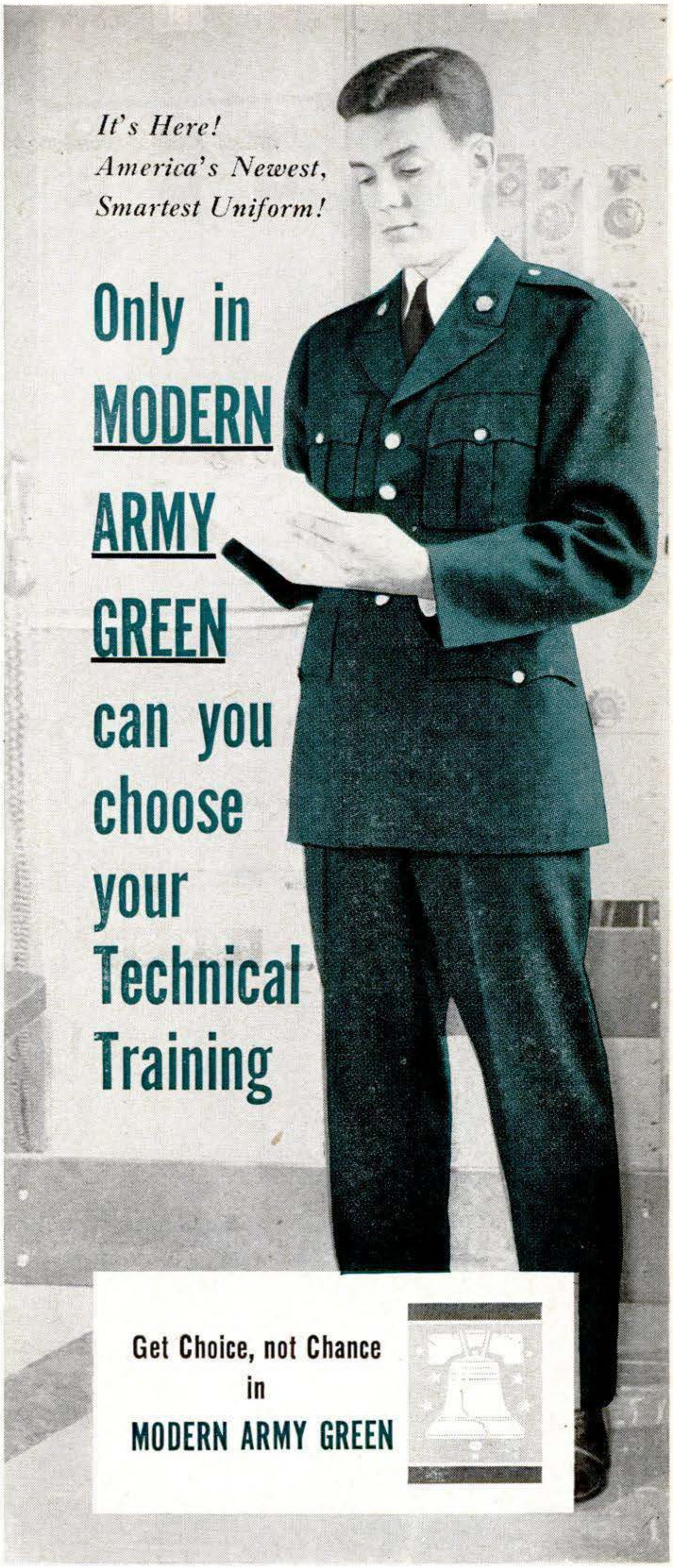

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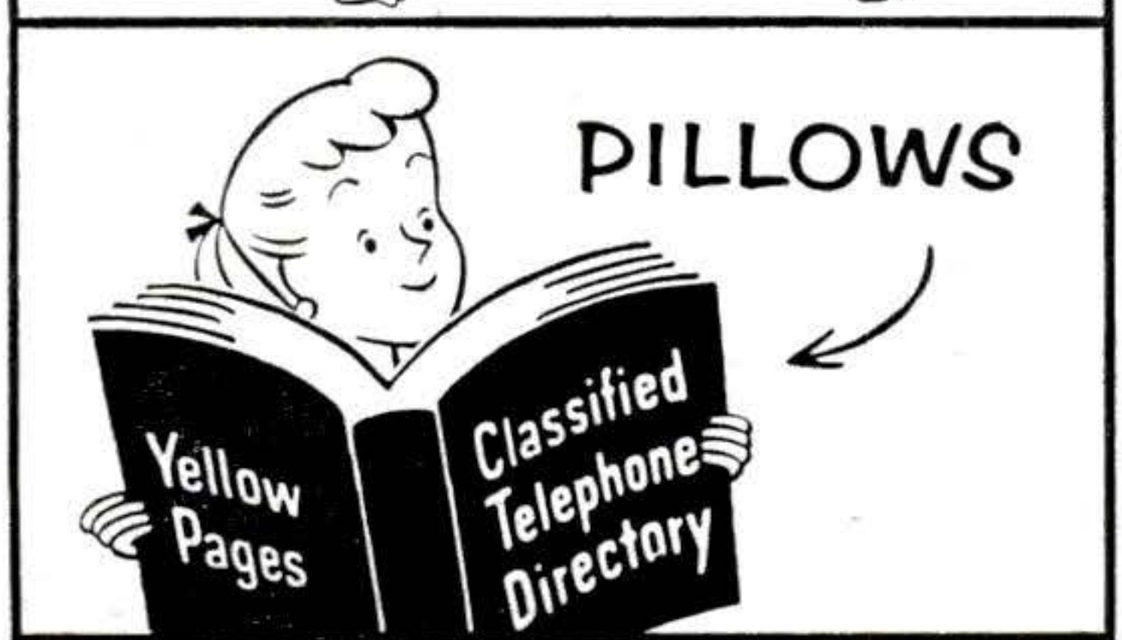

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New PS Record Tests Your Hi-Fi

[*Continued from page 186*]

the fundamental (filtered-out) tone even though it isn't there.

But this isn't merely an intriguing trick. It has an important bearing on your listening pleasure—as the test record can bring out: Many hi-fi fans go along accepting inferior bass response, until they have heard better.

Anyone's ear gets tired supplying these missing tones after a while. You develop a kind of listener fatigue. If your hearing is doing part of the work your rig should do, you ought to know it.

Other tricks may also fool your hearing, unless you have a way of checking on them. Take your speaker, for example. You may think you're getting a lot of bass for your money when, in truth, the speaker and its enclosure could have a design that peaks the bass output between 100 and 200 cycles.

This juke-box engineering gives a throbbing bass to a rock-and-roll piece. But it tends to make all bass notes sound alike, and to blur the instrumental sounds at the lowest register.

Obviously, you can't expect a modestly priced set to reproduce the very lowest tones. But possibly you'd like a less prominent but cleaner bass—for symphonies instead of rock-and-roll. You'll get a more natural sound if your rig gives a smooth response down to its lower limit.

High frequencies come next, once your bass-note problems are out of the way. It costs a manufacturer comparatively little to give you all the highs you're willing to take. But does your present setup give you real high-fidelity on the highs?

With the test record, you can learn the true role of high frequencies, and why you need them.

The fundamental tones of most instruments fall below 3,000 cycles. So the cheapest box can reproduce the highest fundamental without strain. But, after the fundamentals, what gives an instrument its distinctive personality is its *overtone* pattern. That's why "concert A" on a violin sounds entirely different from the same note played on a flute.

There you have the real reason why you need good high-frequency response. The overtones go up as high as 15,000 cycles with many instruments. And the response must keep the overtones in proper

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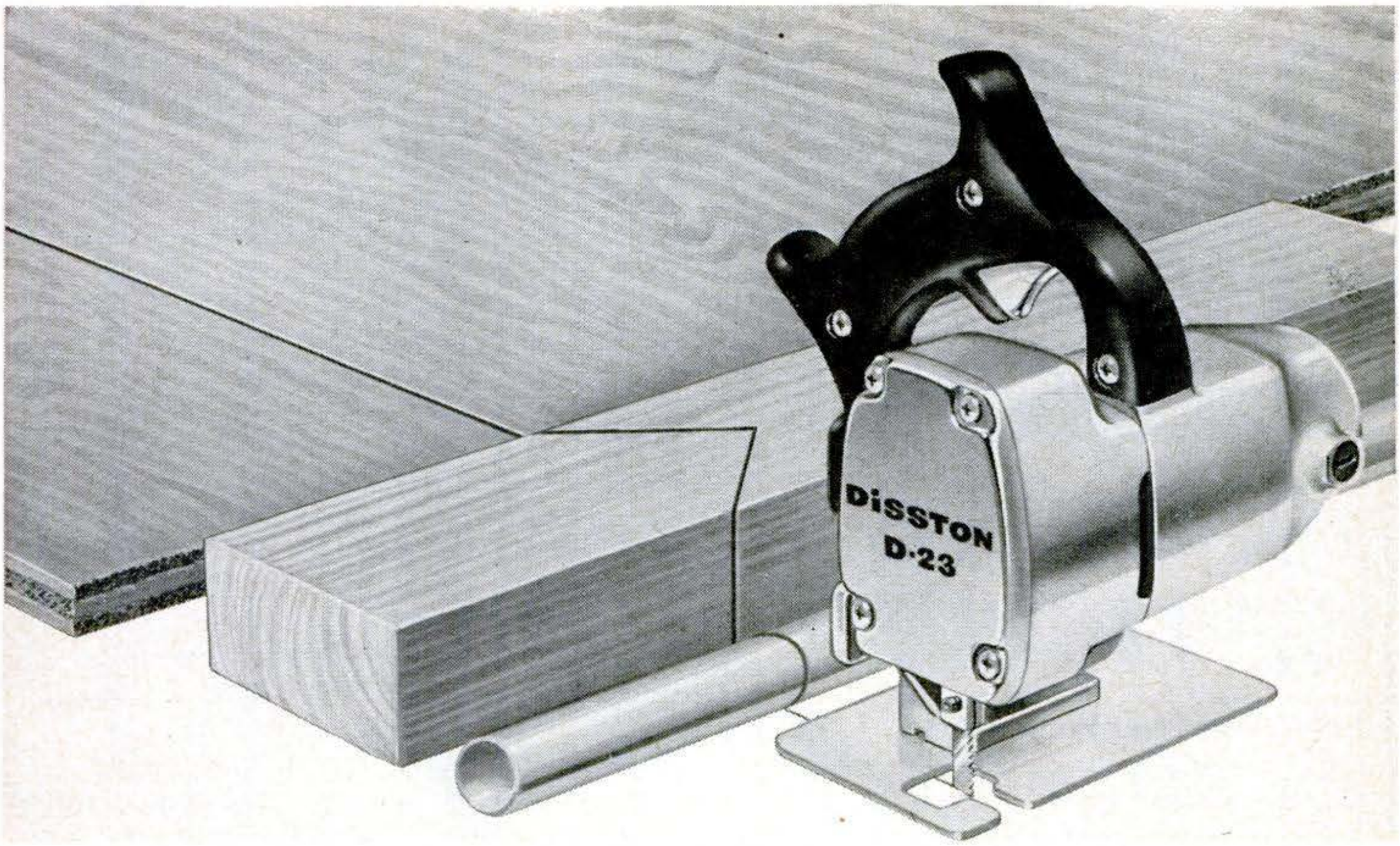

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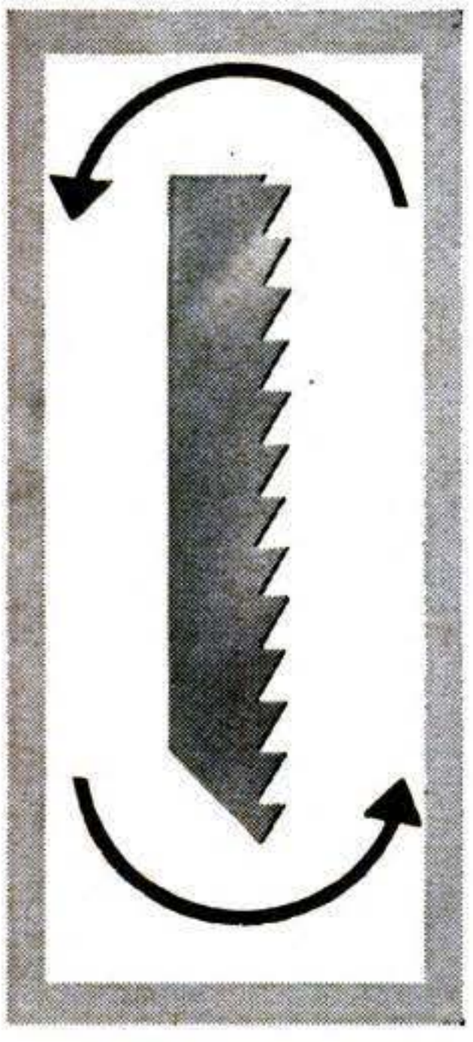

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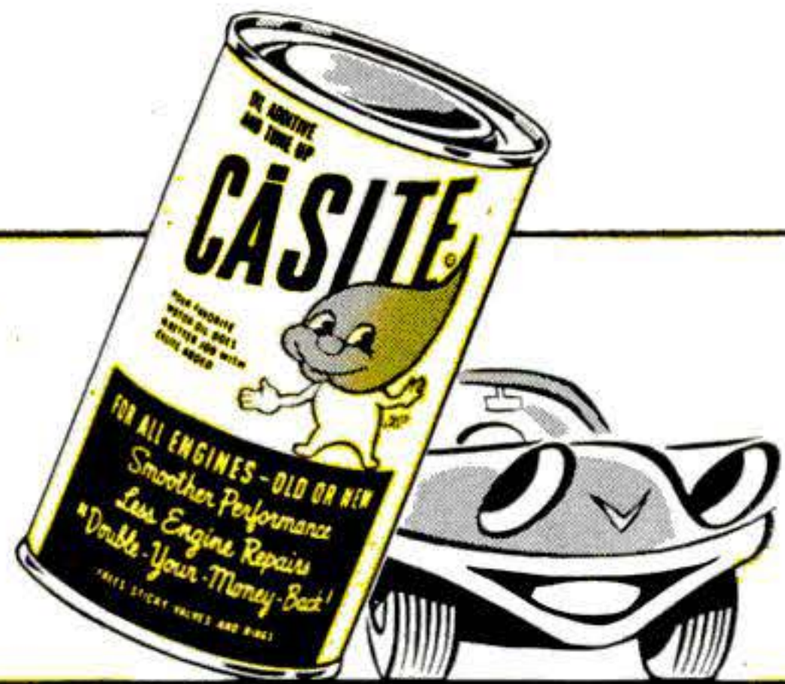

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relationship. Emphasizing particular frequencies will distort the true sound. If your speaker has sharp peaks that favor spot frequencies, it can make the squeaks of the violin bow or tinkle of triangles come through loud and clear, yet reproduce the oboe so it sounds like a clarinet.

One of the record's checks for high-frequency response works like this: A violin, clarinet, flute and oboe play a simple tune twice. The first time, you may think it is the same instrument all the way through. Reason: A filter has chopped off the overtones at the time of recording. The second time, without the filter, the instruments will sound as they ought to. You should have no difficulty identifying their different sounds.

But what if you can't identify them on the second playing? Then here are two possible faults you can check: Your stylus could be badly worn. Or "peaky" speaker response, favoring particular frequencies, may be to blame. If neither part is defective—and you can determine this with still *another* test on the record—what you hear may convince you that it's time to buy a better speaker or pickup.

How do individual instruments sound on your machine as they run through their respective ranges? On the test record, each demonstrates by playing up and down its range. Cut-off filters show what happens when sounds above 3,000 cycles and 6,000 cycles are blocked.

Here's something you should know about instrument sounds, especially if you're in the market for a new tweeter. Do the recorded sounds of some instruments please you more than others? A little-understood characteristic of speakers may cause this. A horn-type speaker, for example, usually gives greater realism to brass instruments, while a cone tweeter often sounds better for the strings.

Another point: Response of the highs at one end of the range and the lows at the other should be a matter of balance. The right balance between the two ends makes more difference in how good your rig sounds than a few extra cycles at either end will ever make.

Say your pocketbook dictates a hi-fi rig with a bass response that stops at 100 cycles (better bass response is costly, remember). Then your rig will sound better if its high end is limited to about 5,000

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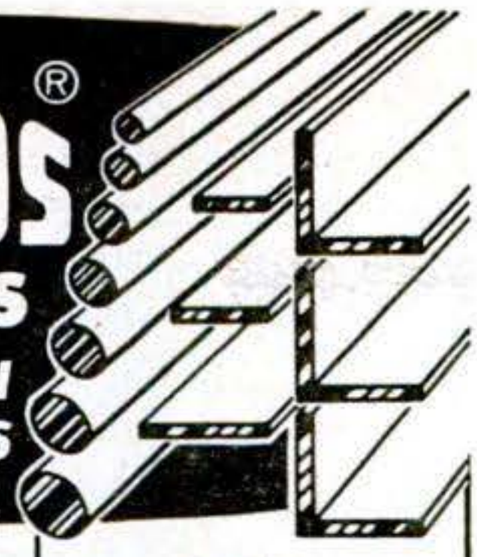

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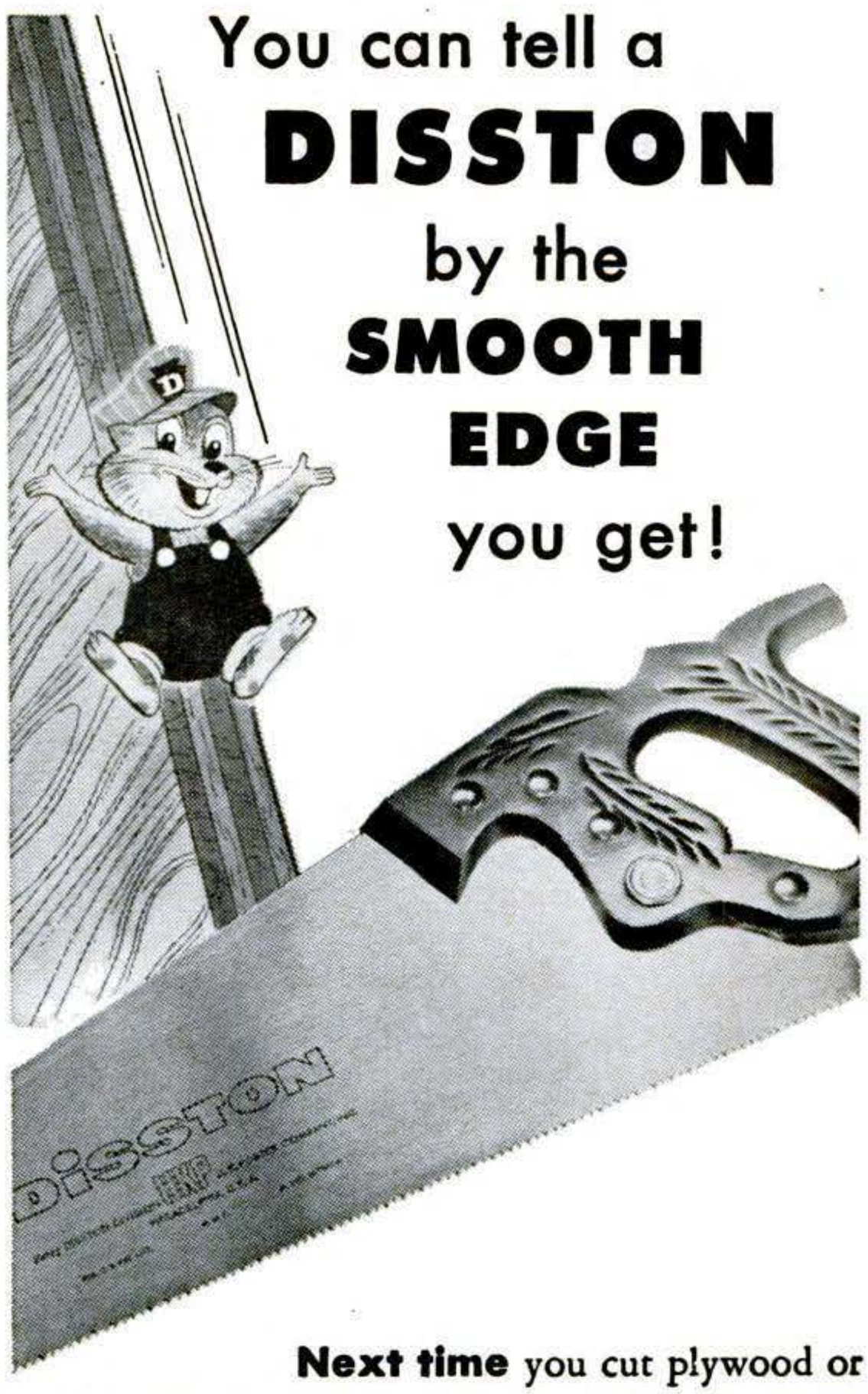

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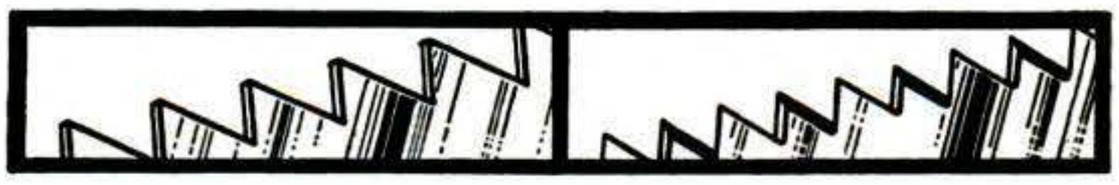

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Question 2

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Question 3

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cycles. But if you insist on going *up* to around 15,000 cycles, then your rig must also reach *down* to 30 or 35 cycles in order to give you the most pleasing results.

Mechanics as well as electronics helps reproduce the music you hear. Music is a succession of tones that are always starting and stopping. To reproduce it faithfully your rig must start a sound without hesitation, end it abruptly. The ability to do this is called transient response.

Instruments that are struck or plucked —piano, drums, harpsichord—make the greatest demands in transient response. Clean reproduction of such tones demands violent acceleration and braking of the moving parts in the speaker and pickup.

So these are the parts most likely to let you down. The electronic parts, having only weightless electrons to deal with, seldom cause trouble here.

The PS record manual gives you tips on tracing troubles and curing them. You can check not only the overall transient response, but find the component responsible for poor performance.

Sometimes the trouble is just a wad of goo collected on the stylus. Or you may need to increase the downward force on the pickup. If the sound hangs on after the tone stops, the trouble is probably in your speaker or its enclosure. Whatever the source, the record will help track it down.

Dynamic range is another hi-fi characteristic you should be aware of. It is the contrast you hear between the softest and loudest sounds at a particular volume setting. The maximum range is predetermined by the recording itself.

But the contrast often diminishes as the months pass. Age is a villain for even the best systems.

You aren't likely to notice the slow deterioration. But here, too, periodic checkups with the Popular Science Test Record can help you keep your hi-fi equipment up to peak performance. END

NEXT MONTH: Ready-made hi-fi? Right! No need now to solder together a lot of separate parts. For a guide to the best value, see January PS.

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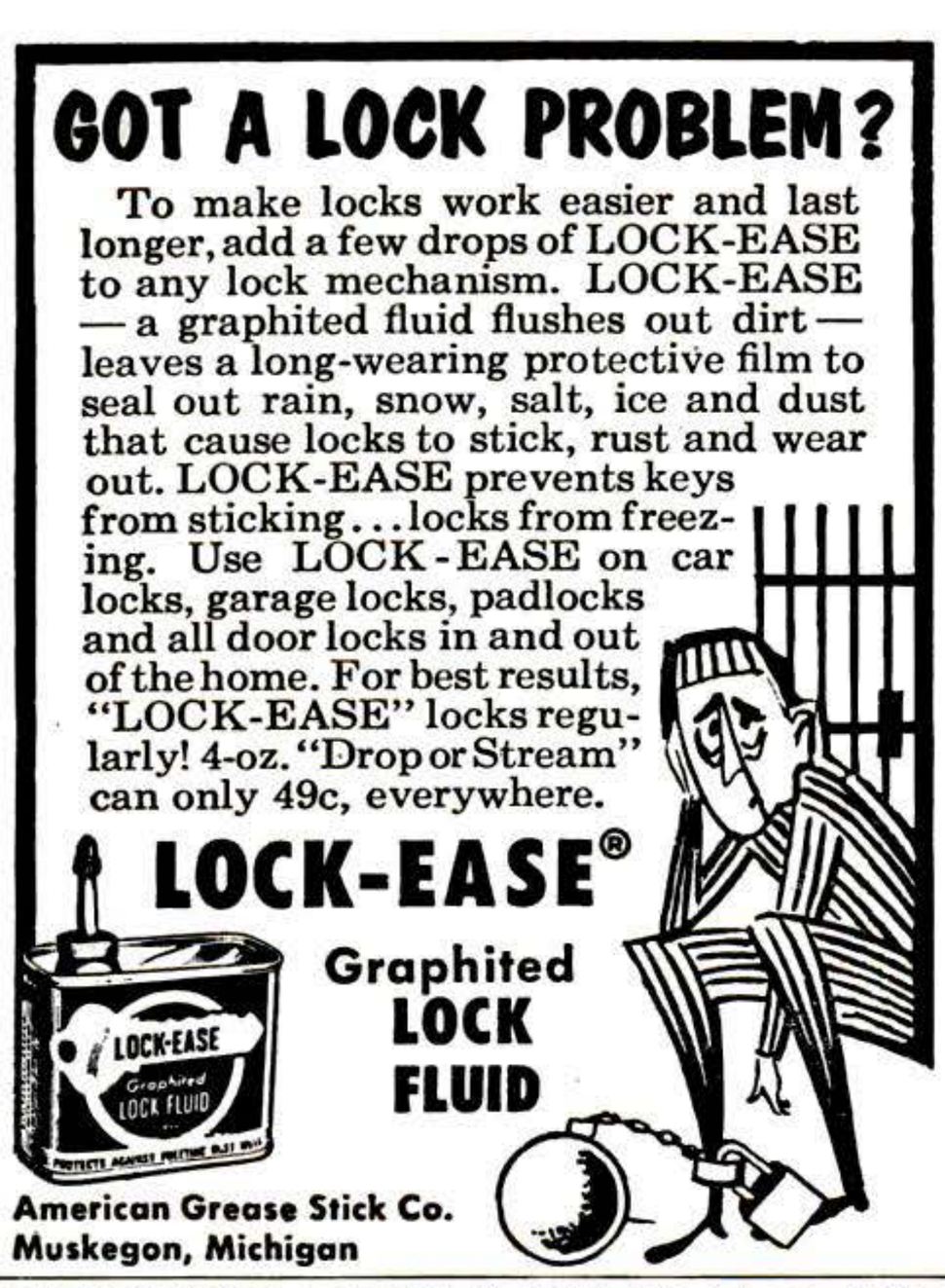

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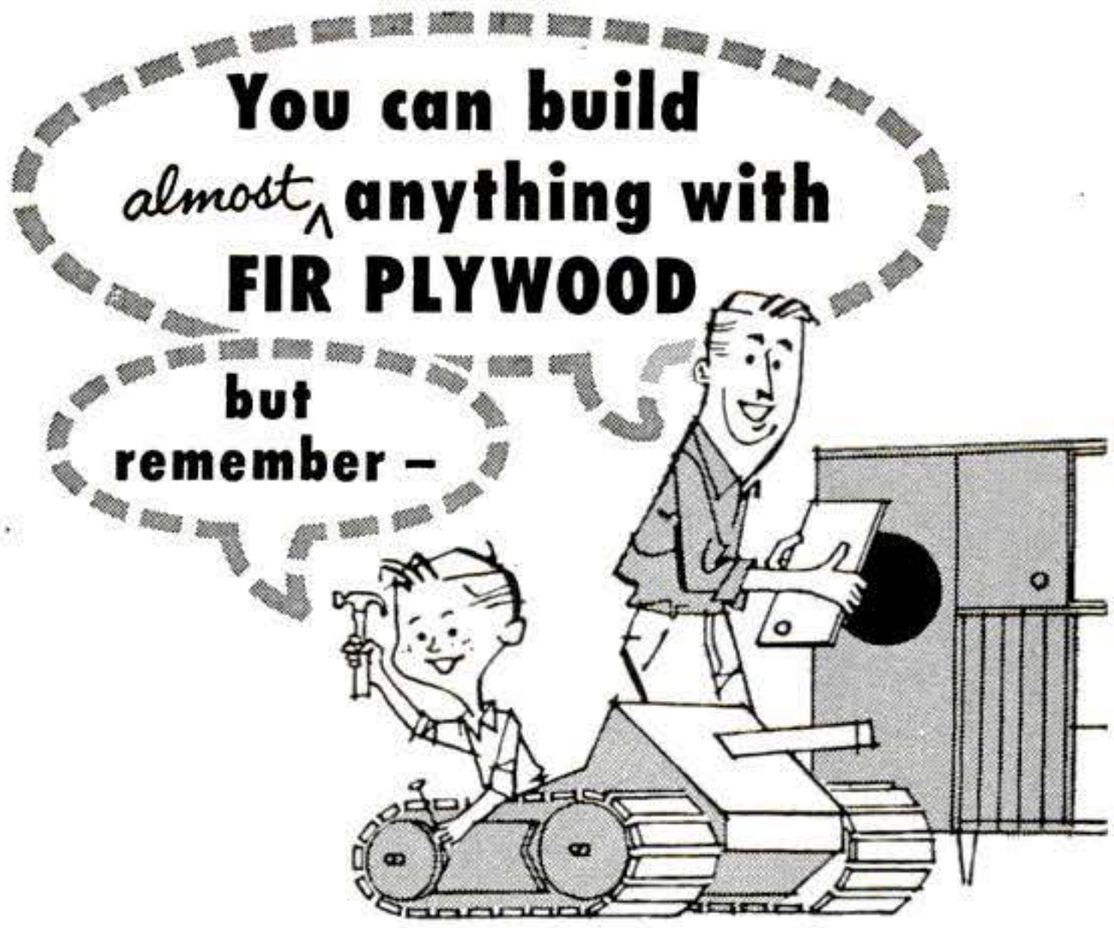

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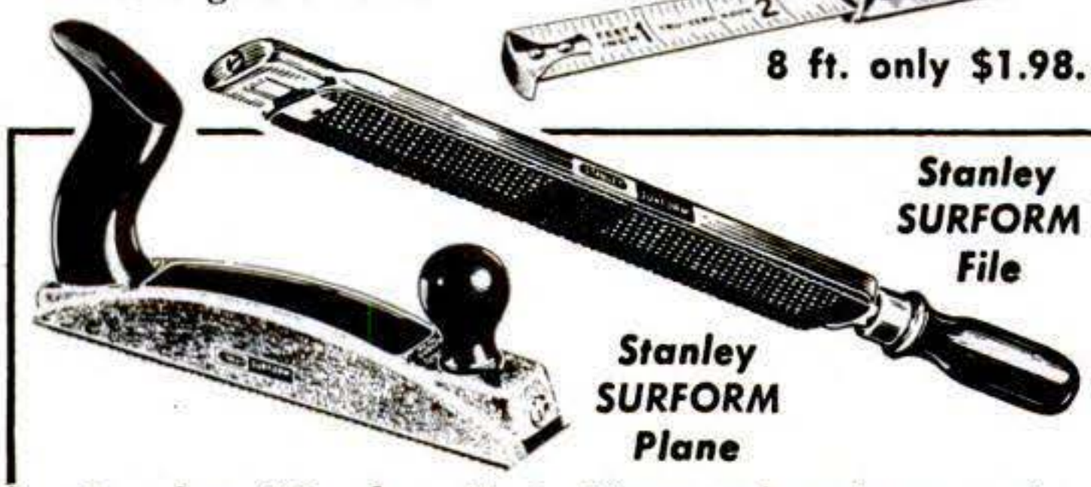

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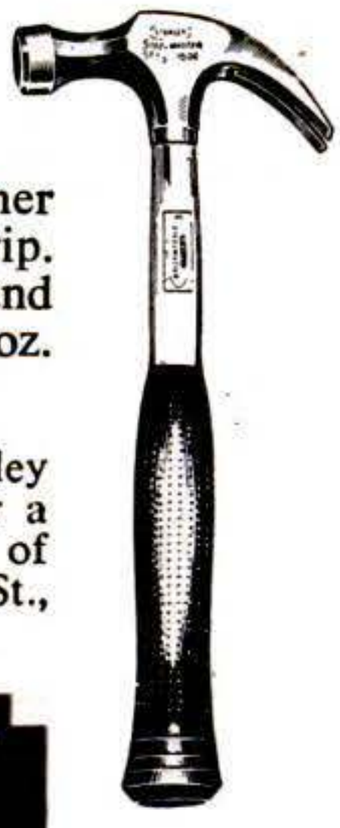

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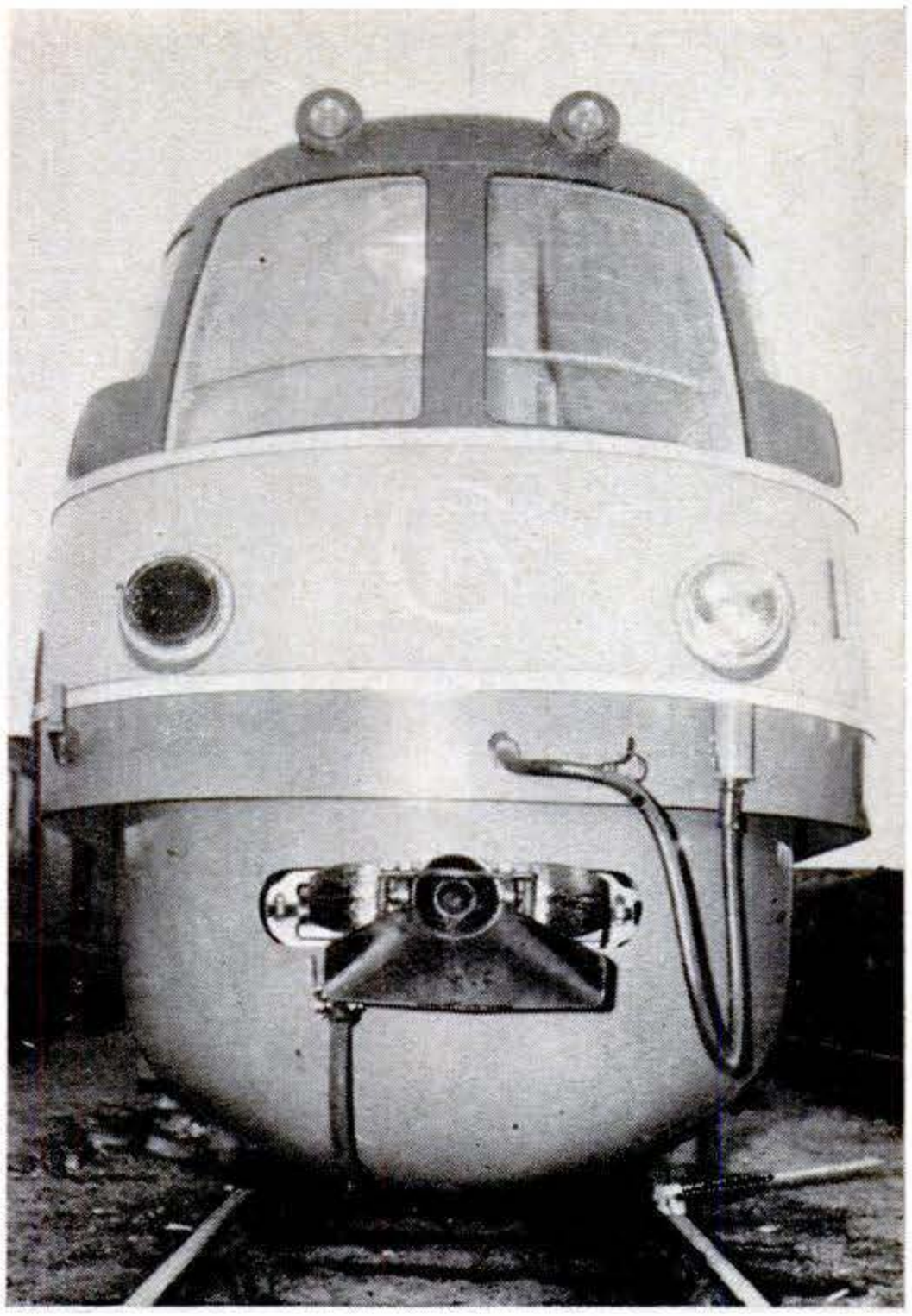

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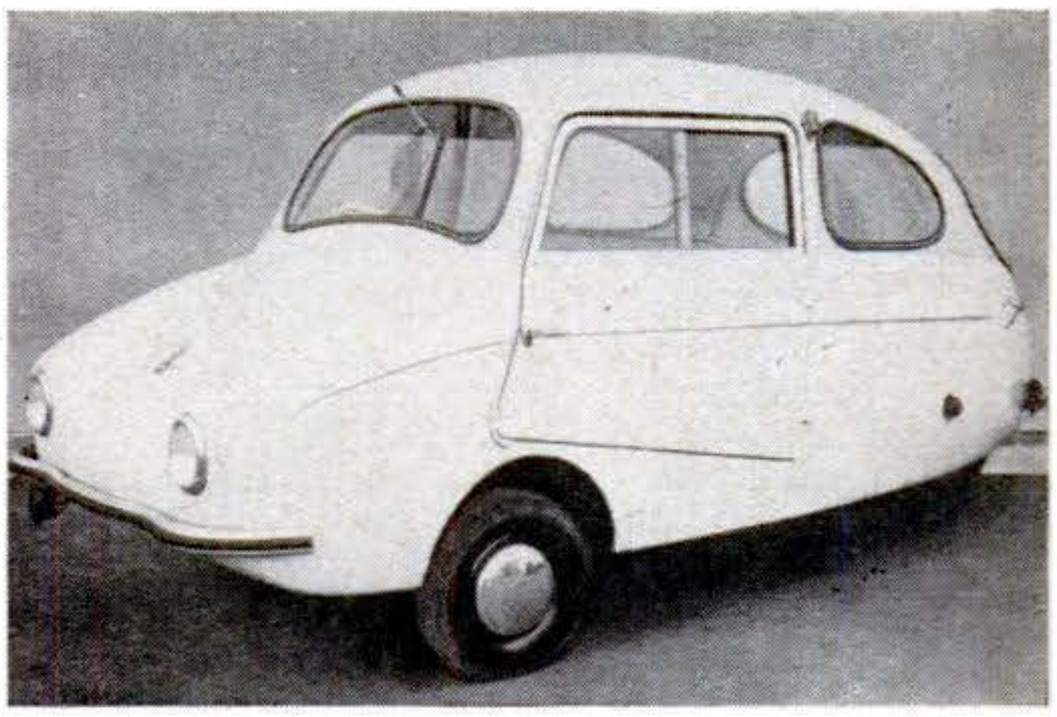
A NEW French self-propelled railway car (above) is always on the level. There is no cant, so they say, even when it takes a curve without slacking its 110-m.p.h. speed. The overhanging upper section of the car tilts on the undercarriage.



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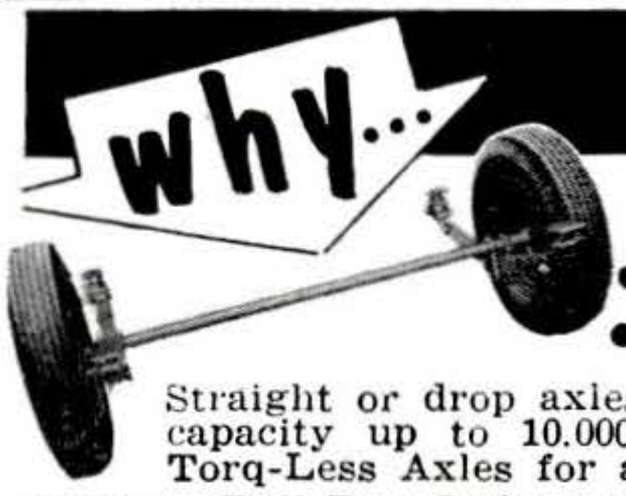

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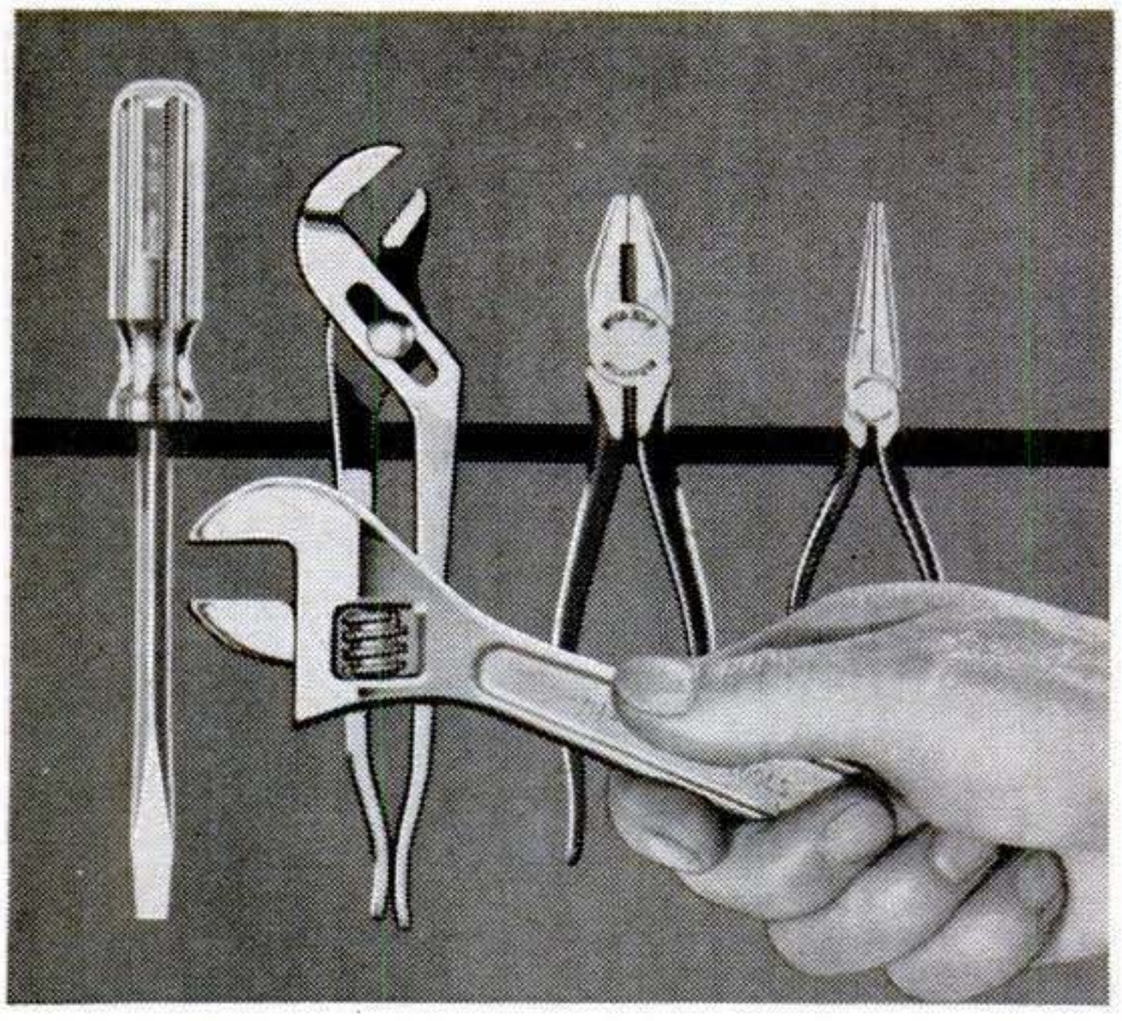

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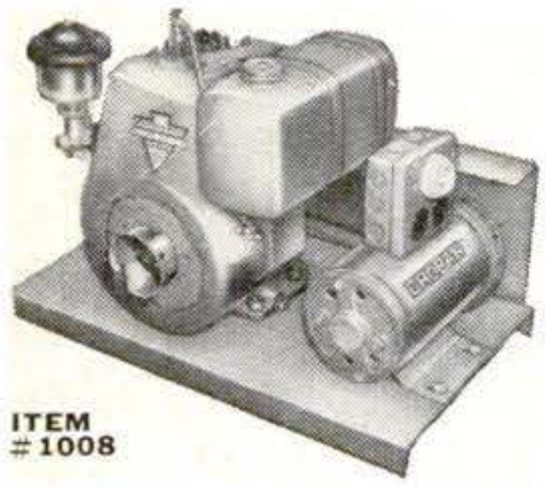

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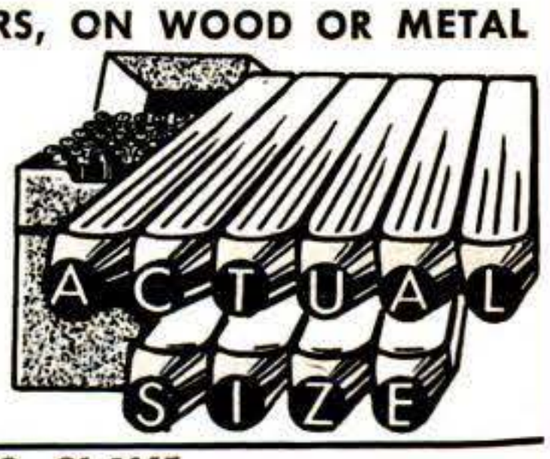

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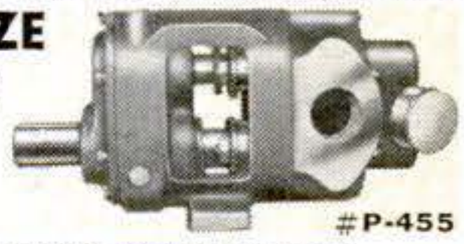

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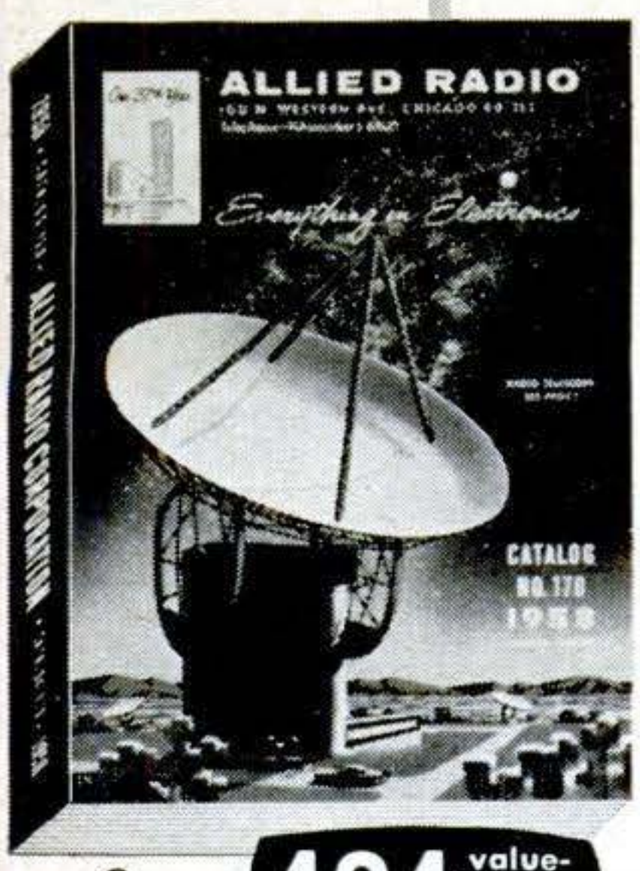

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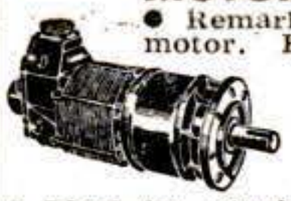

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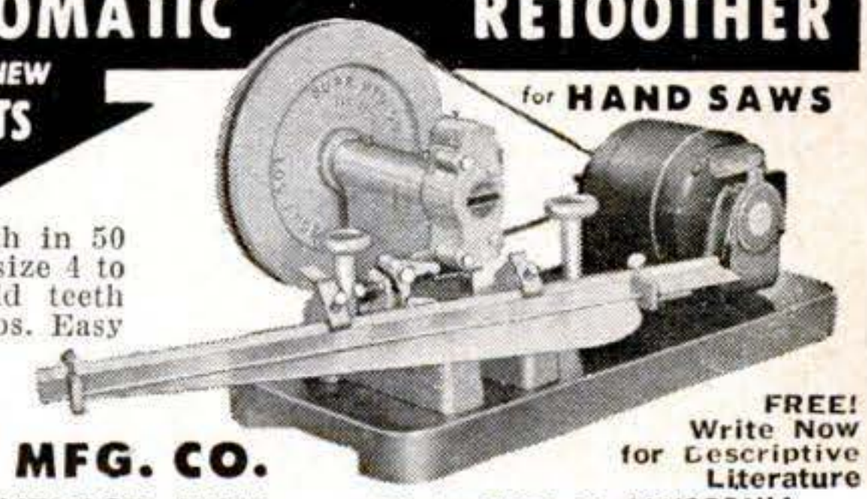

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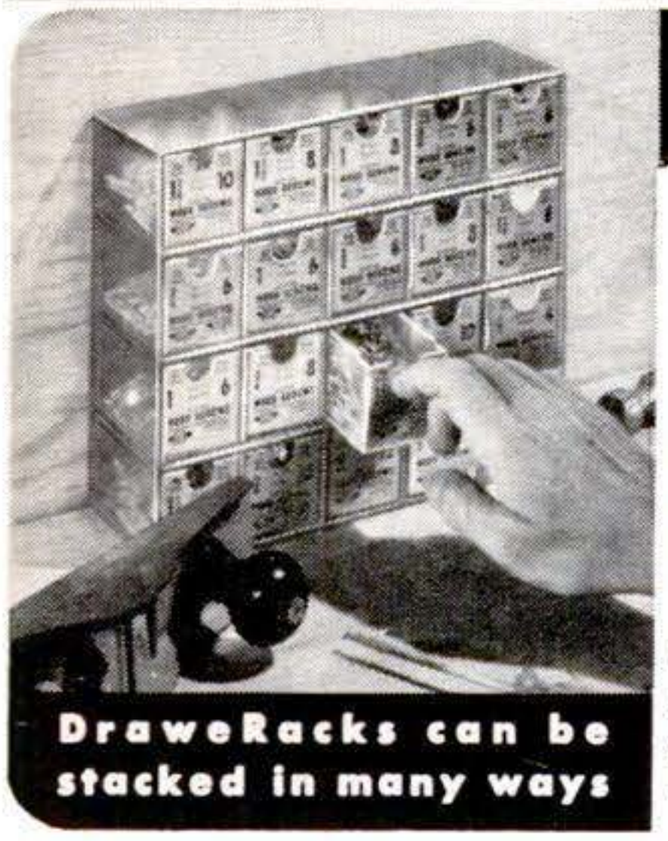

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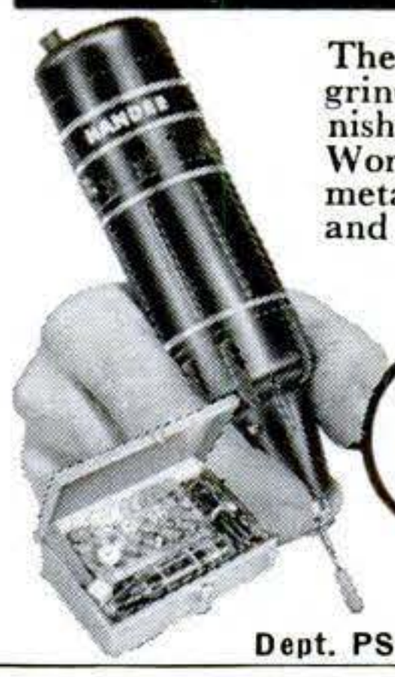

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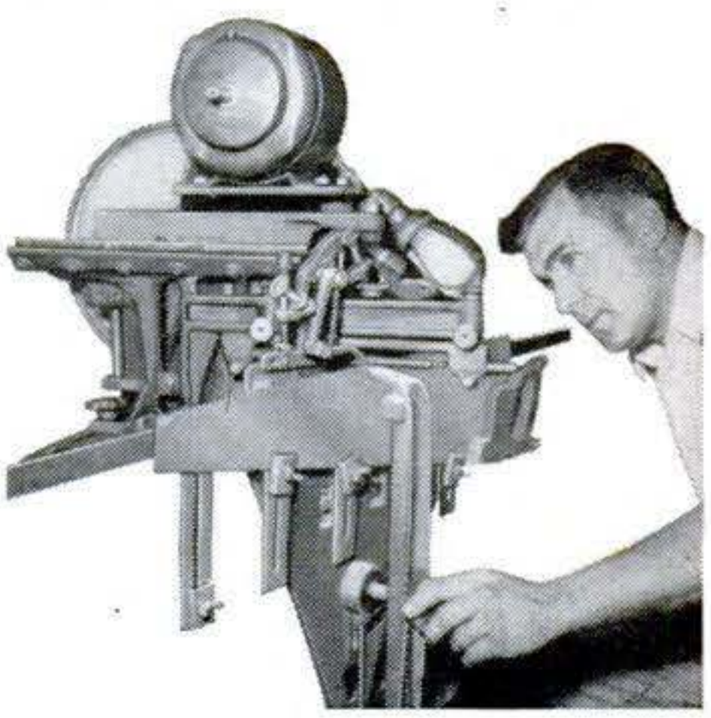

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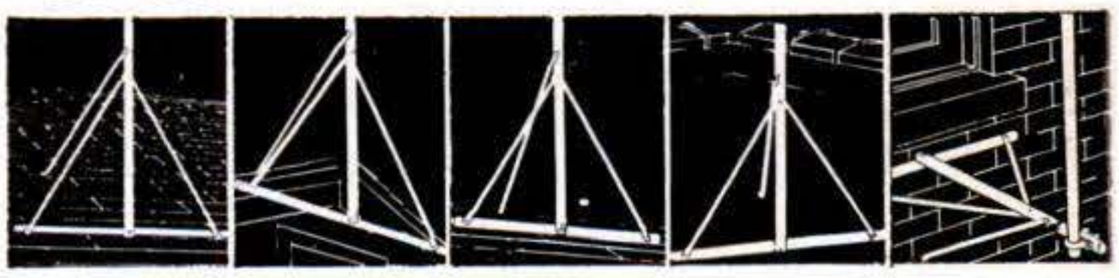

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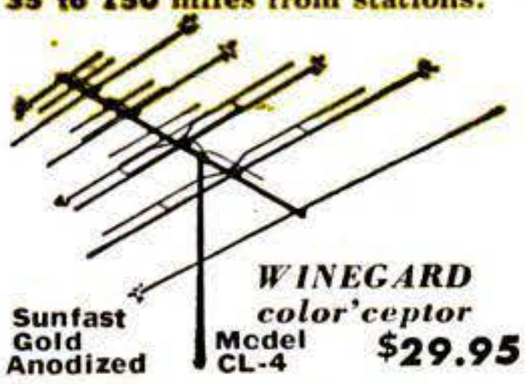

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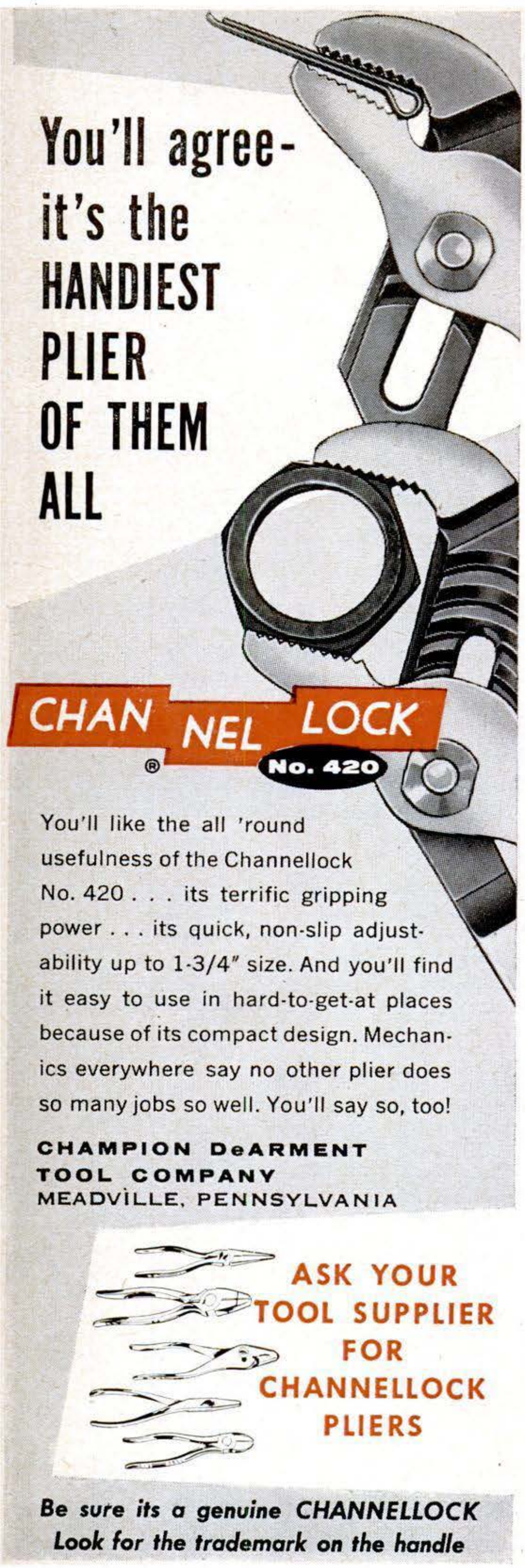

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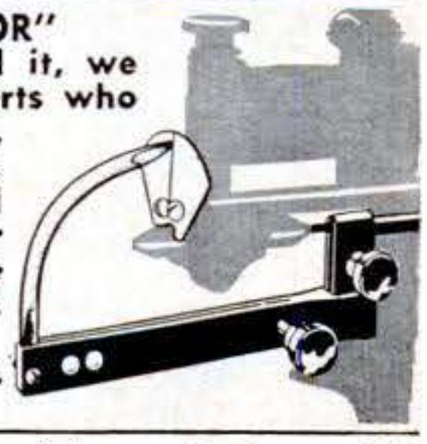

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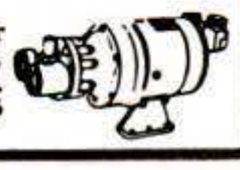

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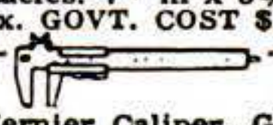

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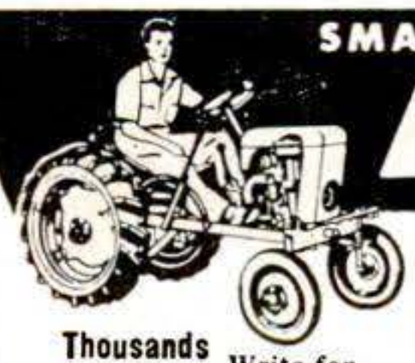

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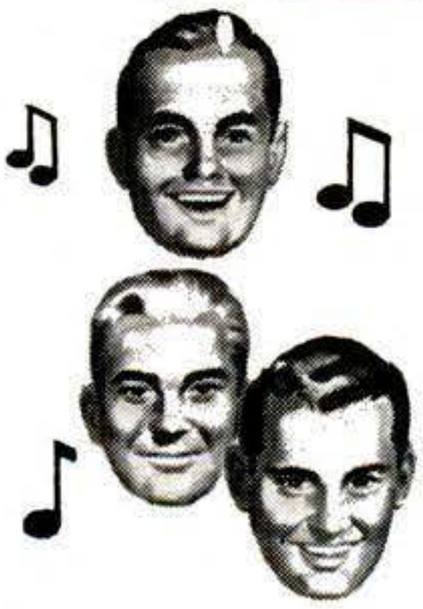

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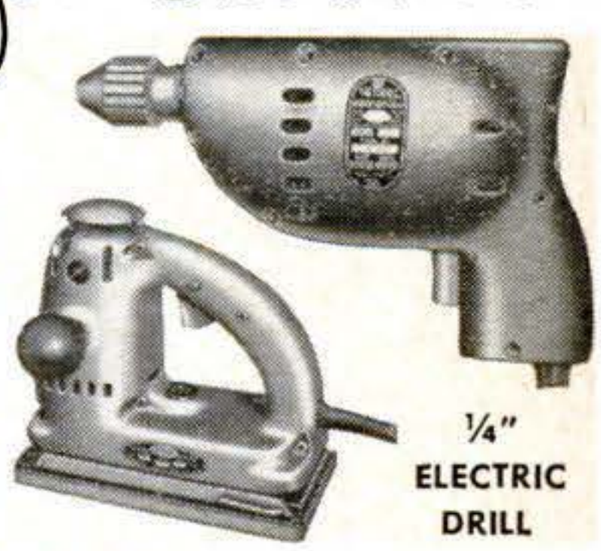

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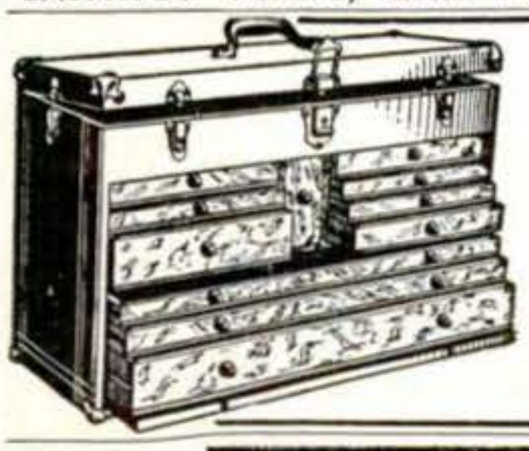

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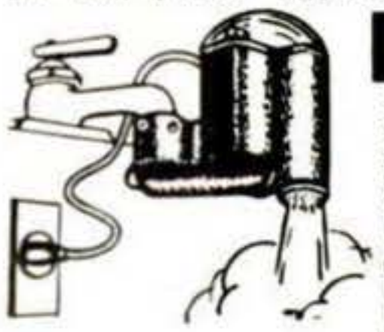

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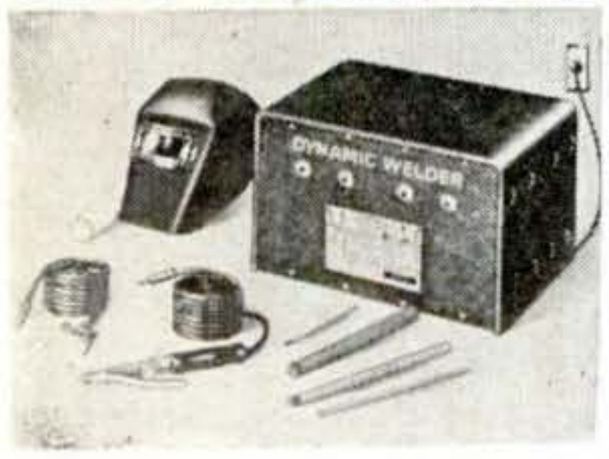

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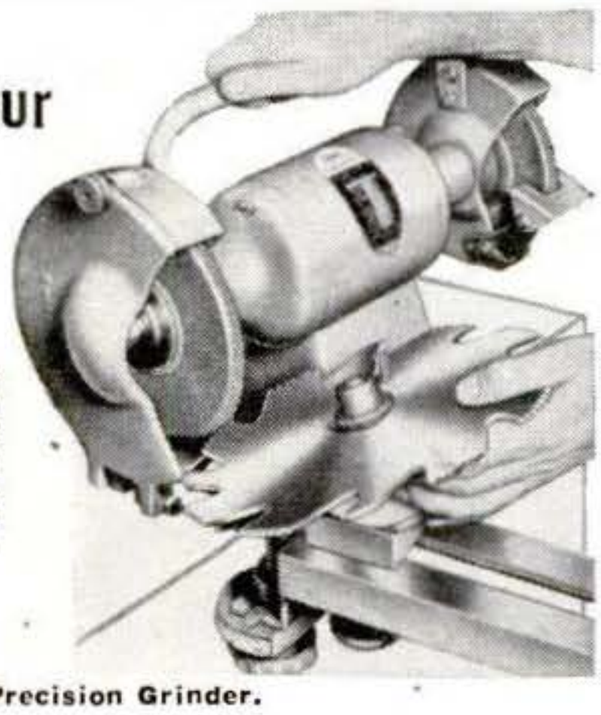

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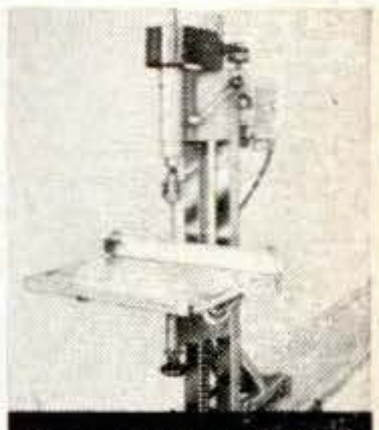

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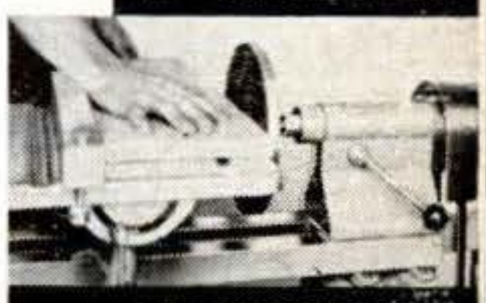

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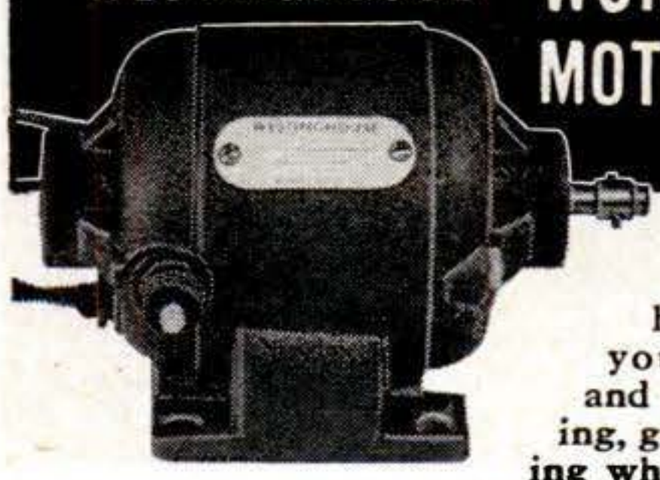

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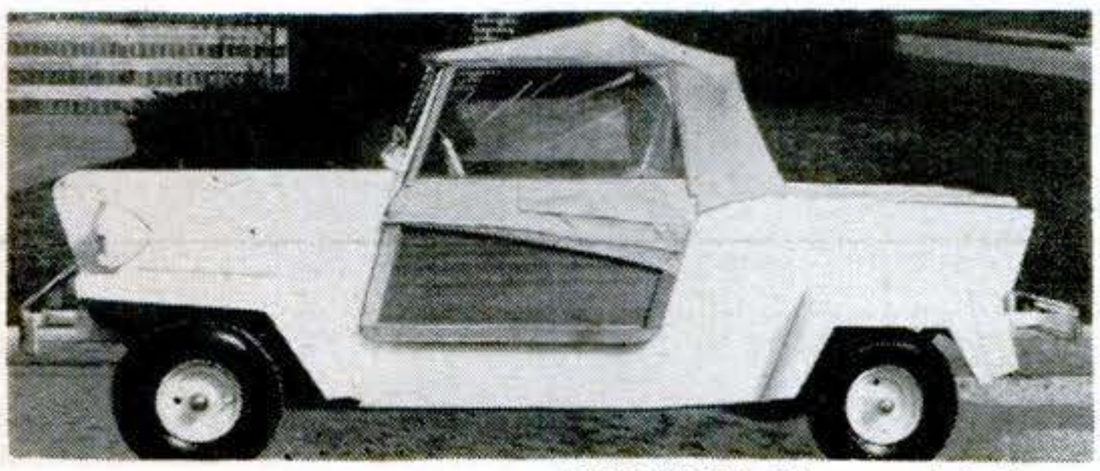

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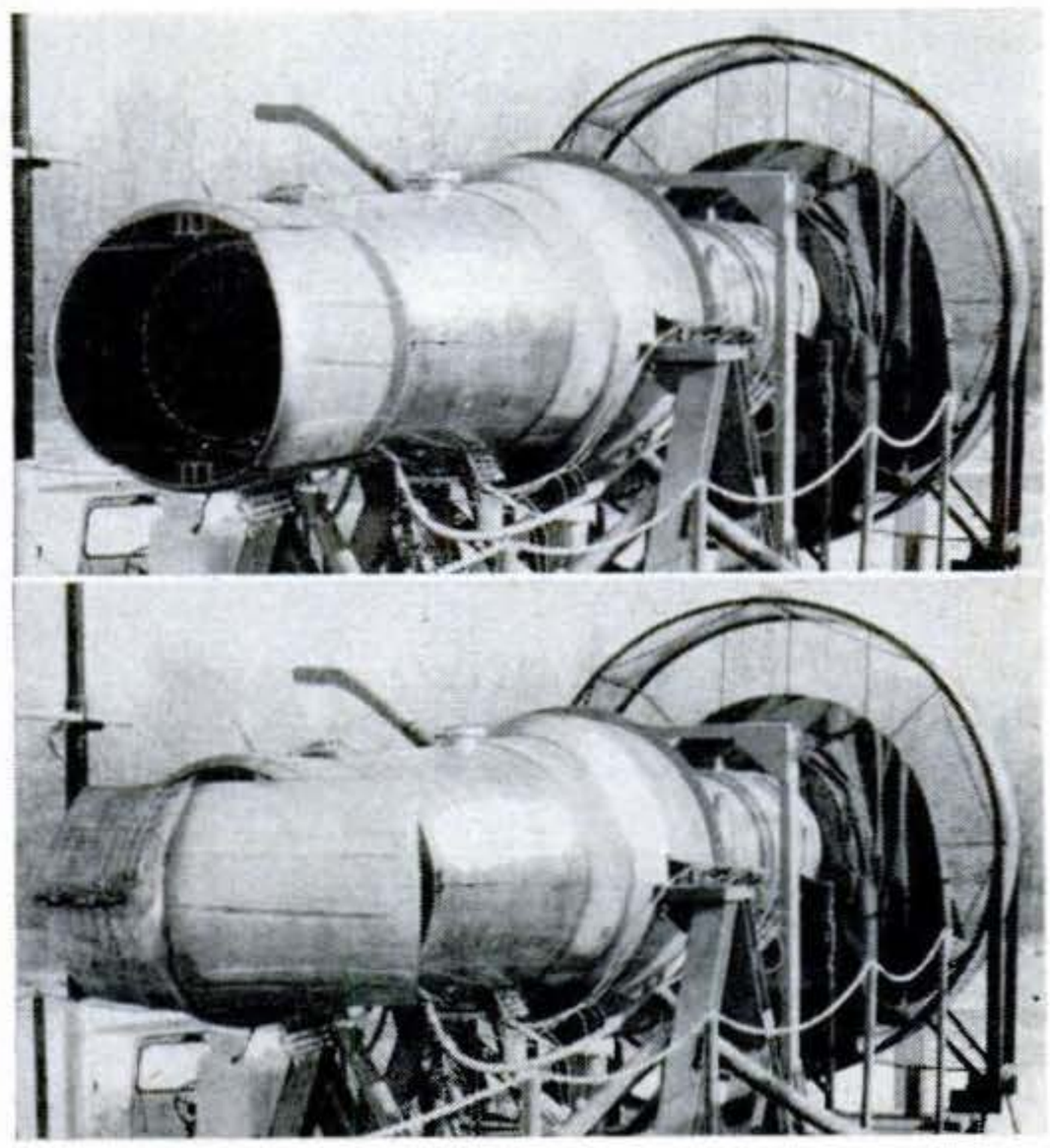

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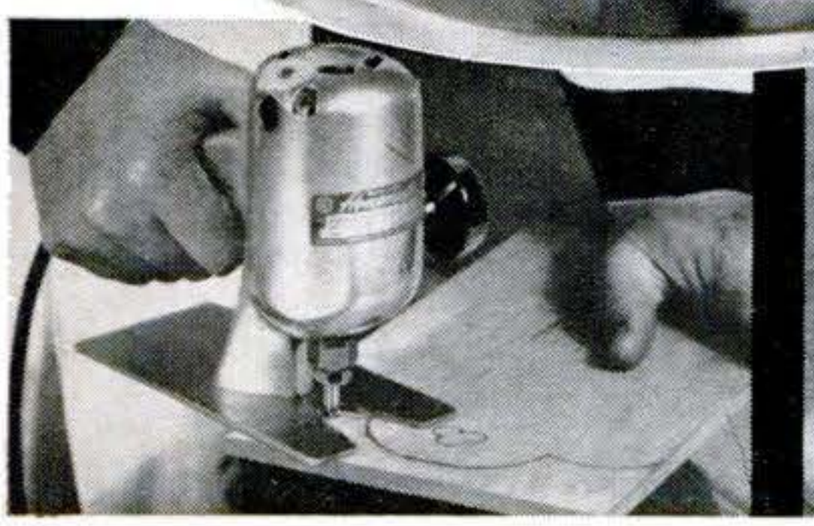

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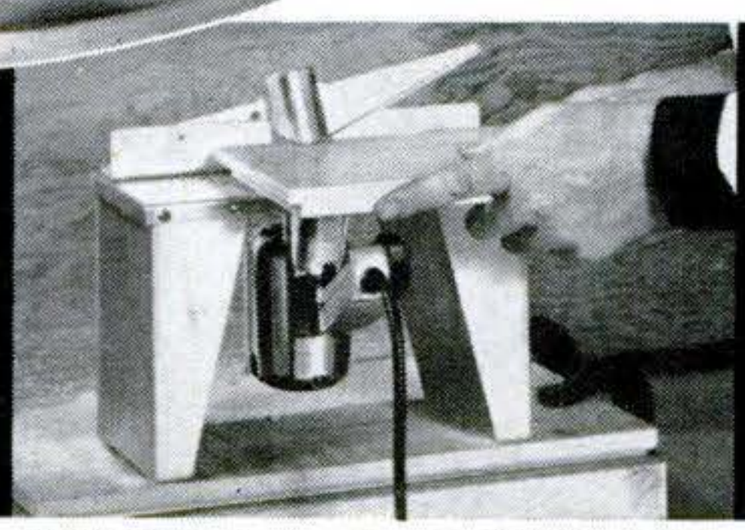

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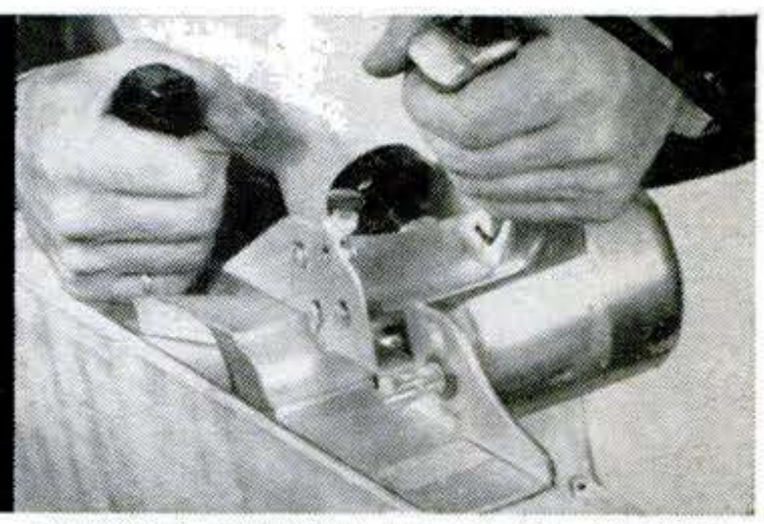

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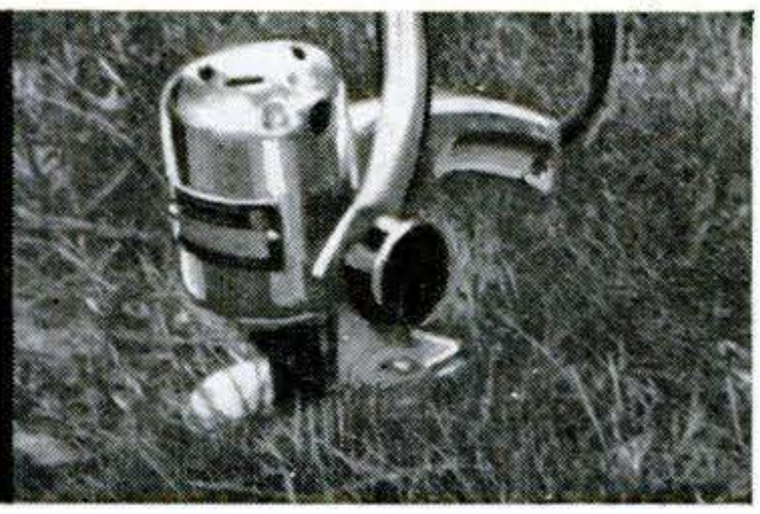

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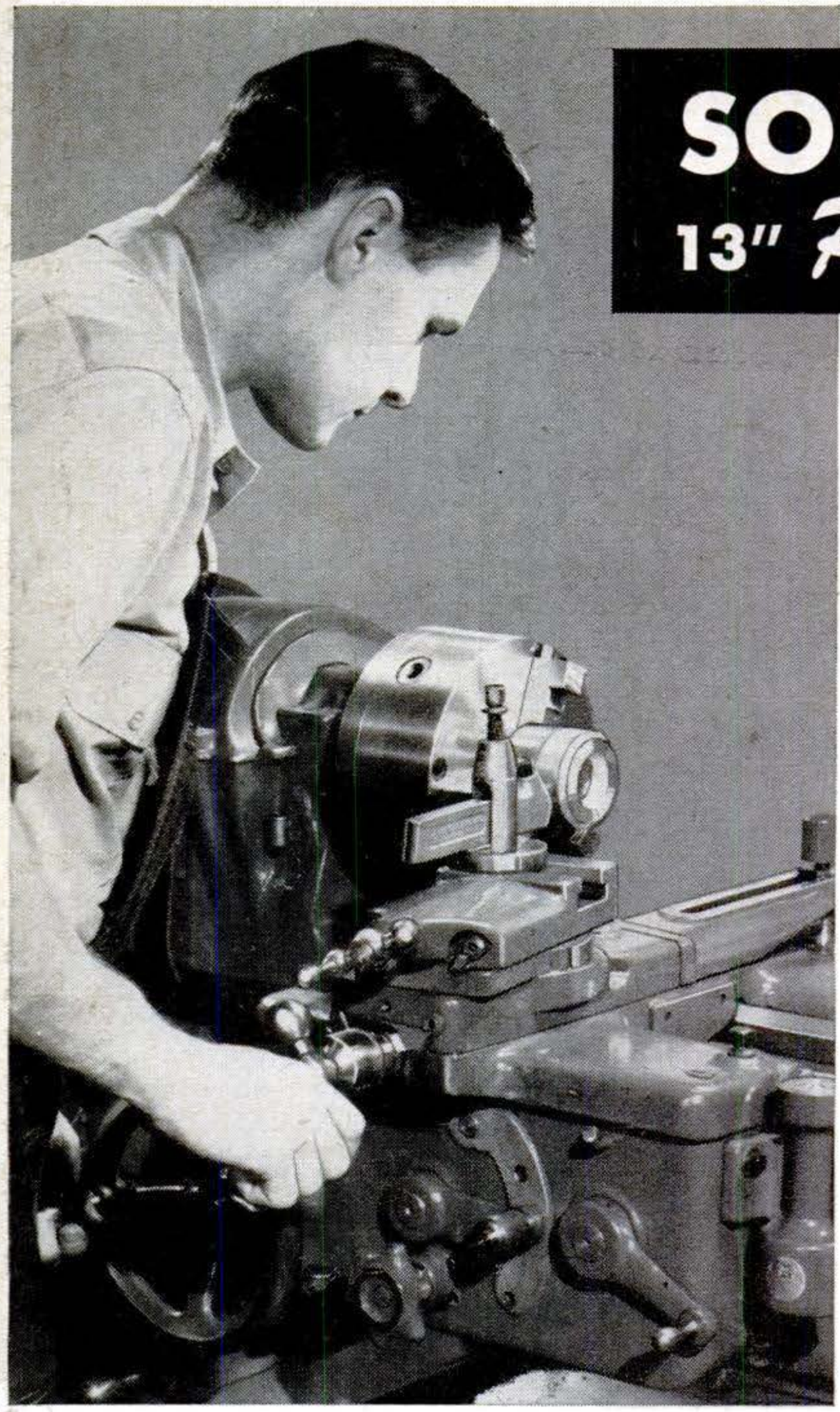

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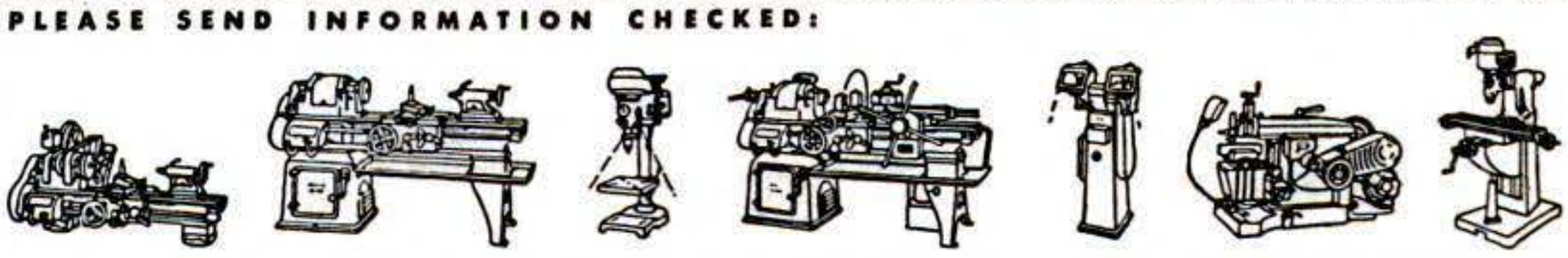

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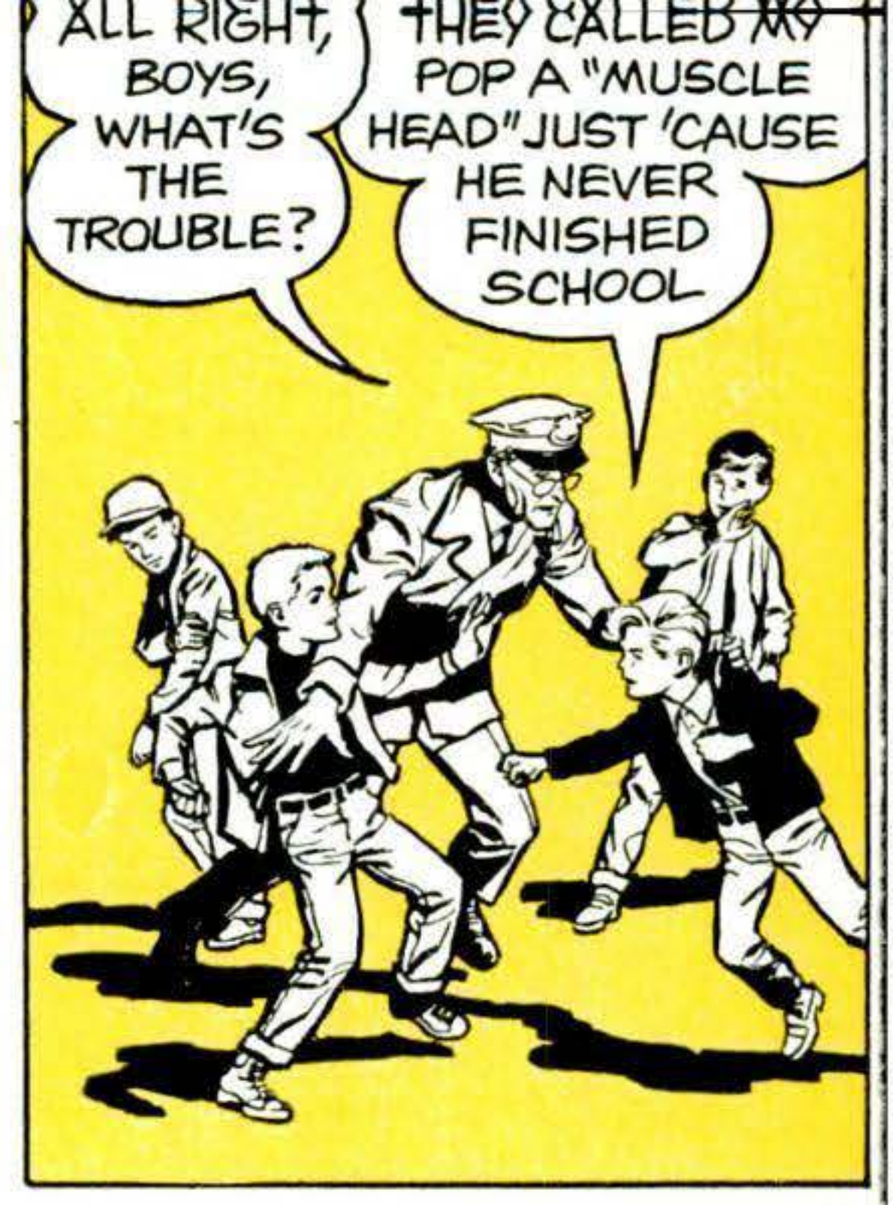

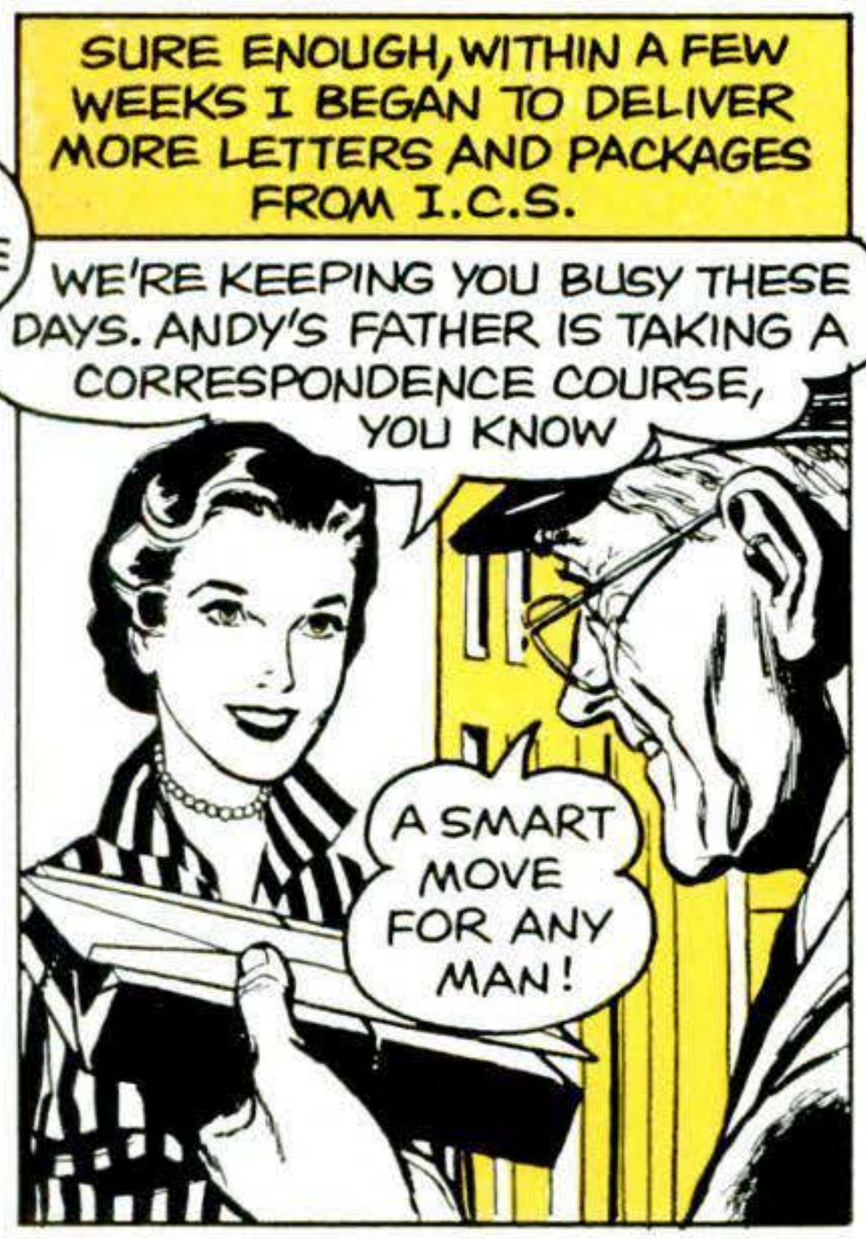

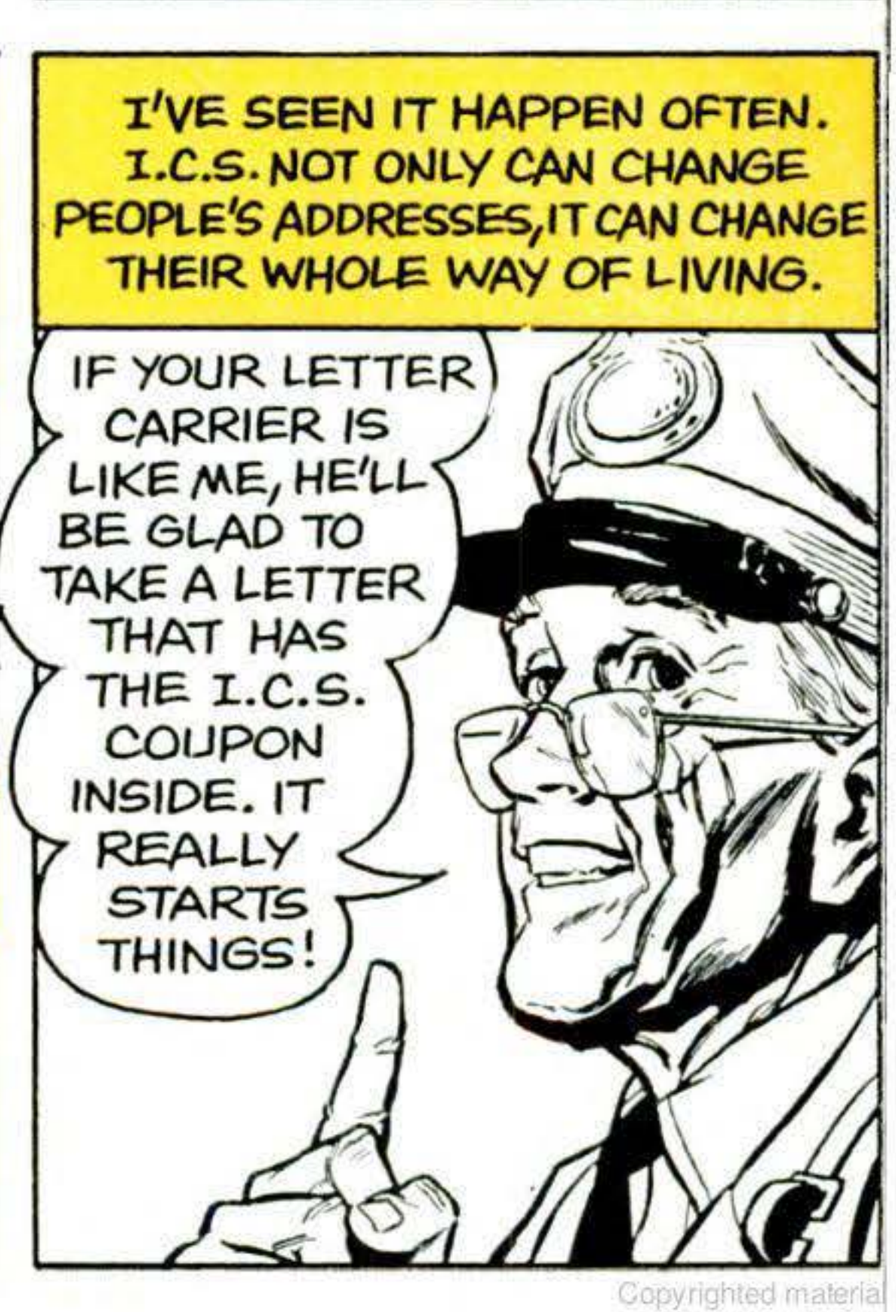

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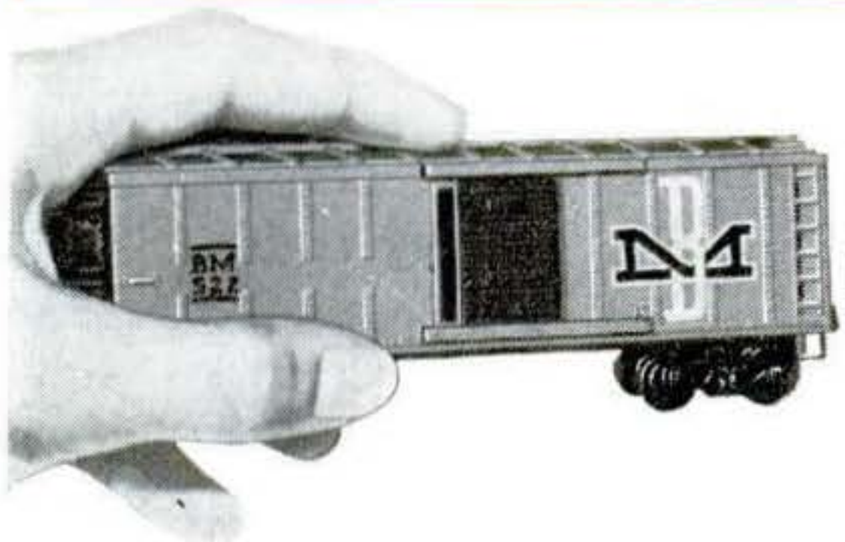

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